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THE RECENT SCIENTIFIC MISSIONS FOR THE MEASUREMENT OF ARCS OF THE MERIDIAN IN SPITZBERGEN AND ECUADOR.

BY

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The annals of scientific advancement have recently been enriched by two achievements which have involved distant and perilous operations on the part of a joint commission of Russian and Swedish scientists in Spitzbergen and of a commission of French scientists in Ecuador and Peru, and which, in their results, are destined to exercise an important influence in the larger problems of geography and to form a contribution to the array of observational facts which lie at the foundation of a vast field of inquiry in astronomy, physics, and geology.

The principal purpose of each of these expeditions was the measurement of an arc of a meridian of the Earth, but, in addition to the geodetic measurement, both expeditions took occasion to gather extensive and valuable data in relation to meteorology, terrestrial magnetism, topography, geology, and natural history.

Four hundred years ago, when the memorable discoveries of Columbus, Gama, and Magellan doubled in a single generation all that had been previously known of the surface of the Earth, the spherical form of the globe ceased to be a scientific theory and became a demonstrated fact; and a new era of geography was opened in which men, believing the globe to be a sphere, began to make rude measurements upon its surface to ascertain its size. These measurements, as we know, at length, after nearly two centuries, reached an extent and precision sufficient to prove that its surface was not

spherical. Then the Earth came to be looked upon as a spheroid of revolution, and, with the lapse of time and the accumulation of measurements, the dimensions of the spheroid that represents the actual globe more closely than any other spheroid have been determined. But, as further and more accurate data are measured, alterations in these elements are sure to follow, and to show more and more precisely wherein the actual geoidal form differs from a spheroid of revolution and whether a better approach to its mathematical form woud be arrived at by viewing it as an ellipsoid with three unequal axes, or else as an ovaloid.

Eratosthenes, who lived in the third century before the Christian era, seems to have been the first to conceive the principles and make the observations necessary for a logical deduction of the size of the Earth. He noticed that at Syene, in Southern Egypt, the sun at the summer solstice being directly in the zenith cast no shadow of a vertical object, while at Alexandria, in Northern Egypt, the rays of the sun at the same time of the year made an angle with the vertical of one-fiftieth part of four right-angles. From this he concluded that the circumference of the Earth was fifty times the distance between these two places, and this being, according to the statements of travellers, 5,000 stadia, he announced that the whole circumference was 250,000 stadia. The exact length of the stadium is now unknown, so that the precise evaluation of the result of this calculation by Eratosthenes cannot be stated, but it is not thought to differ greatly from the real length of the circumference of the globe.

Such, in its simplest form, is the conception of the geodetic operation usually called the measurement of the arc of a meridian, which, for its successful execution, demands the most accurate instruments, the best observers, and long-continued labour. It is simply to measure the distance between two points on the same meridian, and find their difference in latitude. The determination of the difference of latitude is now usually made by zenith telescope observations at each station, and is perhaps the easiest part of the work. The length of the observed line of the meridian is more difficult to obtain, since it is usually impracticable to find a line of sufficient length running due north and south, and level enough to be directly measured with the implements for linear measurement. Ordinarily, the terminal points are situated on different meridians, and the length of the meridian intercepted between their parallels of latitude has been customarily found, ever since the days of the Hollander, Snellius, by calculation from a triangulation carried on between them. By this method, a

long chain of triangles is formed and all the angles of them are carefully observed. One, at least, of the sides is located on a level plain, where it may be precisely measured by special implements; and, by finding the elevation above the ocean of the ends of this base, its length, and hence the whole triangulation, may be reduced to that surface. For it has been decided that the form of the mean level of the surface of the ocean is the form which a spheroidal surface deduced from geodetic measurements should be designed to represent. Astronomical observations are made at the triangulation stations to determine the latitudes and the azimuths of the sides of the triangles with reference to the meridian; and then, from the known length of the measured base and the known angles, the lengths of all the sides of the triangles and the geodetic positions of the stations are computed. A meridian of longitude is then conceived to be drawn north and south through the triangulation, and also parallels of latitude through each of the stations, and the lengths of the intercepted portions of the meridian between these parallels are computed and added together to give the length of the meridian between the southernmost and northernmost stations.

Between 1690 and 1718, Cassini carried on surveys in France which were probably more accurate than any preceding geodetic operations; and in 1720 he published results from which it appeared that the length of a degree of latitude on the Earth's surface increased toward the equator and decreased toward the poles, or, in other words, that the Earth was a spheroid that is prolate or extended at the poles, and not flattened, as had been determined from the discussion of Richer's observations by Newton in Book III of the first edition of his Principia, published in 1687. Richer, having been sent to Cayenne, in equatorial South America, on an astronomical expedition, noted that his clock, which kept accurate time in Paris, there continually lost two seconds daily, and could only be corrected by shortening the pendulum. Men were then aware that the time of oscillation of a pendulum depends upon the intensity of the force of gravity, and Newton showed, after making due allowance for the centrifugal force, that the force of gravity at Cayenne as compared with that at Paris was such that Cayenne was further from the centre of the globe than Paris, and that, therefore, the Earth was an oblate spheroid, flattened at the poles. As a result of the dispute that arose among philosophers of those days as to whether the shape of the globe was a spheroid flattened at the poles, as indicated by the investigations of Newton, or a spheroid extended at the poles and flattened around the equator, as appeared from the work of Cassini,

the French Academy resolved to reach a definite settlement of the question by sending out two expeditions with the object of measuring two meridian arcs, one in the equatorial and the other in the polar regions. Accordingly, two parties sailed in 1735—Clairaut and Maupertuis to Lapland, and Bouguer, La Condamine, and Godin to Peru. The Lapland party measured its base on the frozen surface of the River Tornea, executed its triangulation and latitude observations, and returned to France in less than two years with data which gave for an arc of the meridian of 1°-37′-19.57″ a length 180,287.7 meters, and for a length of 1° of latitude 111,949 meters. The Peruvian expedition was absent about seven years, and set out stations forming forty-three triangles between Cotchesqui and Tarqui, which are about 220 miles apart. Two sides of these triangles were carefully measured several times with wooden rods. From these bases and the measured angles the length of the meridian intercepted between the parallels of latitude of the two extreme stations was found to be 344,736.8 meters, while from the astronomical observations the difference of latitude of these stations was 3°-07′03.46″, and the length of 1° of latitude 110,565 meters. Since the surveyors neglected to determine the elevation of their base lines, exact means for reducing the triangulation of this elevated Peruvian arc to the mean level of the surface of the ocean, to which all other geodetic measurements entering into the modern discussions of the size and shape of the Earth have been referred, have never been supplied. At the same time, the Cassini surveys of France gave a value intermediate between the other two for the length of 1° of latitude in that part of the world.

If the Earth were a perfect sphere, one arc of a meridian measured with precision would be enough to determine the value of its radius; but as it is plainly a spheroid, and as a spheroid requires that two dimensions be known in order that its size be determined, it is evident that at least two measured arcs of meridians are required. And when the three measures that were derived from the surveys in Lapland, France, and Peru were taken, two and two, for the purpose of deducing the size and shape of the Earth, each of the three combinations of data gave a different value for the ellipticity of the meridian, whereas, if the Earth were really a spheroid of revolution and if the measurements were truly made, these values of the ellipticity should be the same. To settle the question as to whether the assumption of a spheroidal surface is incorrect or the surveys were inaccurate, a number of meridian arcs were measured in different parts of the world during the course of the follow-

ing generation or two, and a culmination of the eighteenth-century undertakings of this nature was reached in the investigation by the French for the derivation of the length of the meter. This work was under the charge of the celebrated astronomers Delambre and Méchain, and the meridian arc extended from the latitude of Dunkirk on the north to that of Barcelona on the south, embracing an amplitude of nearly ten degrees. In this survey the methods of the measurement of bases and angles were greatly improved, and were brought within the range of comparison with similar works of modern precision, as has been proved by the measurement of this meridian arc, executed, during the years between 1870 and 1892, by Perrier and Bassot. This latter survey was joined on the north with the chain of triangles extending northward over Great Britain to the Shetland Islands and on the south to the triangulation which spreads southward not only over the Spanish peninsula but beyond into Algeria, so as to embrace within its present extremities an amplitude of about 29 degrees. Indeed, during the nineteenth century, the vast extension of trigonometrical surveying in the principal seats of enlightenment and wealth in the northern hemisphere resulted in a great increase in the store of observations, relating to the middle latitudes, for conducting mathematical investigations with a view of determining the size and shape of the Earth; and there have been published many investigations and combinations, made according to the method of least squares or the principles for the adjustment of observations that were announced by Legendre and elaborated by Gauss in the early part of the last century. The most important of these are the ones published by Bessel in 1841 and by Clarke in 1866 and in 1880. The material employed by Bessel consisted of the Peruvian and Lapland arcs and eight others situated in Russia, Prussia, Denmark, Hanover, England, France, and India. The sum of the amplitudes of these arcs is about 50.5°, and they include 38 latitude stations. In the discussion of 1866 by Clarke, the data were derived from the Peruvian arc and five others situated in Russia, Great Britain, France, India, and South Africa, including 40 latitude stations and embracing a total amplitude of over 76°. The rediscussion by Clarke, published in 1880, deduces the elements of an oblate spheroid which will best satisfy the ellipsoidal and geoidal forms which have been the subject of the most important modern contributions to our knowledge of the figure of the Earth. The material employed includes, again, the ancient Peruvian arc, together with the modern triangulation extending over Great Britain and France, the Russian arc of 25°, the Indian arc of 24°, and one

at the Cape of Good Hope of 4½°, making a total of nearly 80° in amplitude, with 56 latitude stations.

In the modern discussions, the older measurements have been superseded by the results of more recent and precise operations, excepting in the instances of the measurements made under the auspices of the French Academy in the first half of the eighteenth century in the very high latitudes and the very low latitudes. The Lapland arc was short and the Peruvian arc was not reduced to the sea-level, and in relation to both of them the instrumental means were lacking for arriving at the degree of precision which is now attained in such measurements. Indeed, marvellous advances have been made in geodetic science during the last one hundred and fifty years, not only in instrumental precision but in the theoretical methods of computation. At the beginning of the nineteenth century, for instance, the measurement of the angles of the geodetic triangle was so crude that the spherical excess remained undetected, and the process of adjustment by the method of least squares was entirely unknown. The zenith telescope for latitude observations, the electric telegraph for longitude determinations, the self-compensating base apparatus, the method of repetitions in angle measurements, the comparison of the precision of observations by their probable errors, and their adjustment by minimum squares—all these and many other improvements were introduced and perfected during the nineteenth century; and during the same time the theory of geodesy has demonstrated that the mathematical figure of the Earth may be determined independently of any hypothesis concerning the law of its formation, provided that there have been observed at and between numerous stations five classes of data—namely, astronomical determinations of latitude, longitude, and azimuth, base-line and triangulation measurements, vertical angles between stations, spirit-levelling between stations, and determinations of the intensity of the force of gravity. And although many generations must pass away before sufficient data have been accumulated to provide for a thorough discussion answering all the demands of geodesy, yet every important contribution may be influentially applied in the evaluation of those more prominent deviations of the Earth from a spherical form which account for certain irregularities in the motion of the moon and for the precession of the equinoxes, which must enfold within its age-long progress much that will influence the destiny of the Earth.

And so we come to the point of view from which the purpose of the recent measurements of arcs of the meridian in Spitzbergen and in the Equatorial Andes may be plainly seen.

The Quito Meridian Arc.

(*See map.*)

The French undertook their mission in Ecuador as a result of proceedings that were initiated at the meeting of the International Geodetic Association in 1889. The Minister of Public Instruction in France, after consultation with the Minister of War, decided to confide the mission to the geodetic section of the Service Géographique de l'Armée. On account of political disturbances in Ecuador, the year 1899 arrived before the important preliminary reconnoissances, which were recognized as indispensable to the full success of the geodetic operations, were carried out.

In 1900 an appropriation of 500,000 francs was made by the French Government for the purpose of executing the objects of the mission, and in April, 1901, an expedition composed of five officers, a military surgeon, and seventeen non-commissioned officers and enlisted men embarked for Colon and Panama. They commenced the operations in Ecuador in July, 1901.

If it be asked why the French chose to carry forward these important observations here, in a region that formerly belonged to Spain and now belongs to Colombia, Ecuador, and Peru, the answer is that, on examining the continental masses traversed by the equator of the Earth and finding them to be Ecuador, Brazil, French Congo, Central Africa, and the region of the Great Lakes of Africa, we conclude that Ecuador is the best place, because the plain of the Amazon is too unhealthy, the Congo region too lacking in resources, and Central Africa too little known.

The Pacific side of the American continent is bounded by a chain of mountains of varying elevation whose summits in South America, where the chain is known by the name of the Cordillera of the Andes, reach and surpass an altitude of 6,000 meters. In Ecuador a striking feature of these mountains is that they are double, forming two elevated, parallel chains called the Cordillera of the East and Cordillera of the West. And between these two chains there is a fertile, populous, and cultivated valley, consisting of a succession of basins separated from one another by spurs joining together the two Cordilleras. The network of triangulation established by the geodesists extended from north to south throughout this inter-Andean region, utilizing the summits of both of the bounding chains of mountains for placing the triangulation, astronomical, gravity, and magnetic observation stations.

Upon landing in Ecuador the expedition proceeded inland from

Guayaquil to Riobamba, which is in the centre of the valley between the Cordilleras, and, during a sojourn of three months in this region, measured the principal base-line of the triangulation and determined the fundamental astronomical elements of latitude, longitude, and azimuth. The delicate operation of measuring the Riobamba base-line was carried out by clearing and grading a lane from 5 to 6 meters wide for a distance of about 10 kilometers in a nearly level region, and marking its extremities by two masonry pillars in which were embedded blocks of bronze, which bore the limiting marks whose distance apart was to be found. Two measurements were made—the first with the bimetallic base-bar of the Service Géographique, constructed by Brünner; and the second with Järderin's base-measuring apparatus. The base-line at Tulcan, at the northern end of the arc, was measured with Järderin's apparatus alone, while the base-line at Payta, in Peru, at the southern end of the arc, was measured with the new Invar base-bar of the Service Géographique and also by the Järderin system, using three Invar tapes. The two measurements of the Riobamba base-line differed by only 1/500,000 of the total length.

The base-lines having been measured, it was necessary to reduce their lengths to what they would be on the geoid, which is the theoretical surface upon which the triangles are calculated, and corresponds to the surface of equilibrium of the waters of the ocean supposed to be extended under the land and over all the Earth. To ascertain exactly the altitude above the mean level of the sea of the ground upon which the base was situated, it was necessary to run a line of precise spirit-levelling from one of the terminals of the base-line to a position on the sea coast, where a tide-gauge had been installed for the purpose of determining the position of mean sea-level.

Each triangulation station throughout the entire chain of triangles was marked by a cross traced on a block of bronze sealed in the masonry pillar which was built to support the instrument of observation. For the measurement of horizontal angles, an azimuth circle, read by four microscopes, was used; and for the determination of zenith-distances and cutting in points of the third order, the theodolite of the Service Géographique, read by two microscopes. The same theodolite or an astrolabe served for the observations that were made to determine the astronomical latitudes.

When the work of measuring the Riobamba base-line was finished, the expedition was divided into two parties, one of which carried on the work of triangulation while the other measured the

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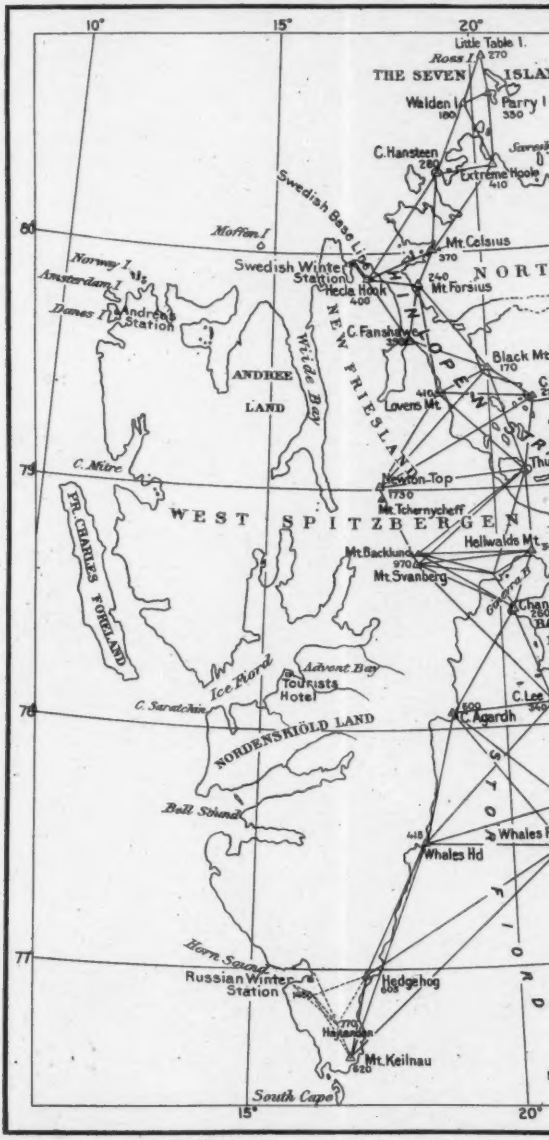
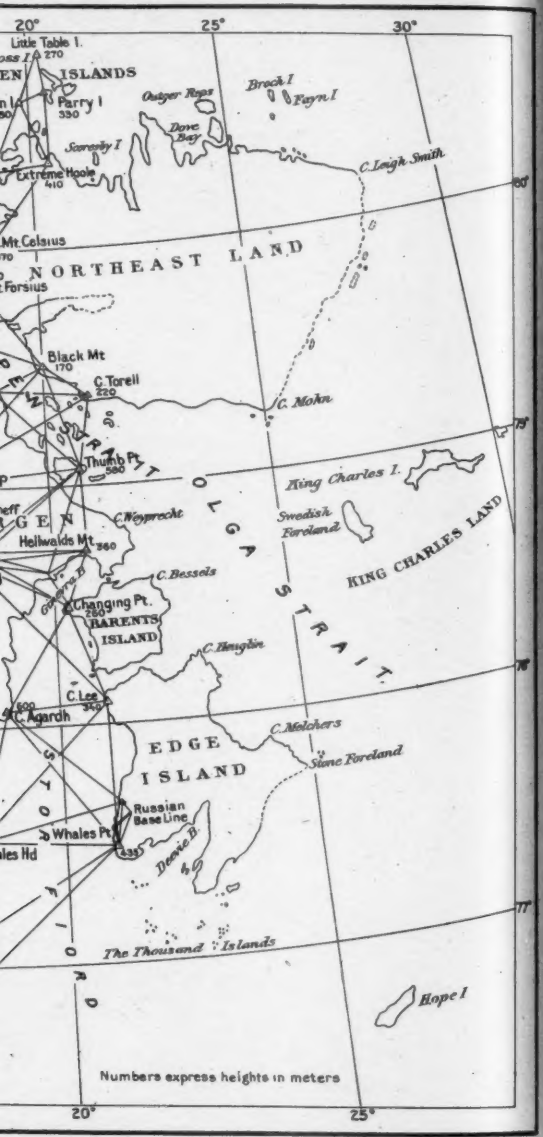


THE SPITZBERGEN MERIDIAN ARC



verification bases at Tulcan and Payta, and determined the latitudes of the extremities of the arc in order to provide data for the evaluation of its total amplitude.

The operations at each triangulation station consisted of the installation of a camp for the observers, the establishment of a block of masonry containing the bronze datum representing the precise position of the station, the construction of a pier about a meter high covering the mark and intended to support in turn the instrument and the wooden signal which was designed to be seen from other triangulation stations. Since in the morning and the evening the vibrations of the air produced by the heating of the atmosphere by the sun's rays are least felt, these periods of the day were employed in measuring the horizontal angles, and the middle part of the day was set aside for the measurements of zenith-distance to serve in determining the relative altitudes of all the triangulation stations. Favourable times were also seized upon for the execution of the topography, the measurement of the magnetic elements, the preparation of star-catalogues, and the computation of field reductions.

Distributed throughout the arc, which has an amplitude of 5° 53′ 34.2″, there were eight fundamental astronomical stations at which the latitude, longitude, and azimuth were determined.

Pendulum observations for measuring the intensity of the force of gravity were made at six stations distributed along a line which traversed the two Cordilleras in order to afford an account of the effect of the considerable relief of the Andes. These observations were made generally in caves or such other surroundings as would insure a minimum variation of temperature during the course of the experiments.

Studies in natural history, ethnography, anthropology, and linguistics were pursued by the surgeon of the expedition, and the magnificent collections resulting from his work have been deposited in the Muséum d'Histoire Naturelle de Paris.

The computations and reductions are not yet completed, but there is reason to believe that the degree of precision necessary to the success of the enterprise has been reached.

The Spitzbergen Meridian Arc.

(*See map.*)

The idea of measuring an arc of the meridian in Spitzbergen was first proposed by Sabine, who had determined the intensity of the force of gravity here in 1823, and thirty years afterwards Torell

induced the Academy of Sciences at Stockholm to attempt a detailed reconnoissance of this archipelago, with a view of determining whether the proper conditions for the execution of such work could be found in this part of the world. They sent Chydenius and Dunér to make an examination, but, on account of the influences of bad weather, a second expedition had to be sent out for this purpose. This second expedition, which was under the direction of Nordenskiöld and Dunér, solved the problem with full success and showed the existence of easily accessible and intervisible elevated points near the coasts which might serve for the location of the stations for extending a chain of triangulation from South Cape in latitude 76° 30′, to Ross Island, at the northern extremity of the archipelago, in latitude 80° 50′, and thus providing for the measurement of an arc of the meridian of about 4° in extent, lying within about 1,000 kilometers of the North Pole. Forty years elapsed, during which the demands of science grew stronger and stronger for the precise measurement of a polar arc of the meridian, before the Academy of Stockholm again took up the question and appointed Professor Rosen to prepare a detailed plan for an astronomical and geodetic expedition to Spitzbergen, to be presented in 1896. This proposition was accepted by the Swedish Academy, which the next year laid before the Imperial Academy of Sciences of St. Petersburg an invitation to join in the execution of this great scientific project. The King of Sweden and the Emperor of Russia both appointed commissions to mature the plans, and in 1898 the work commenced by the sending forth of a preliminary expedition composed of members from both countries to make a final reconnoissance of the territory to be traversed and to erect some of the geodetic signals.

The next year the fully-organized Russo-Swedish expedition started out, equipped not only to carry on the astronomical and geodetic observations incident to the measurement of the arc of the meridian, but also to make observations in relation to geology, botany, zoology, meteorology, and terrestrial magnetism; and, for the more effectual accomplishment of these latter researches, it was decided that a part of the expedition should winter in Spitzbergen.

The Russian party was embarked in three steamships—the Army transport *Bakane,* the ice-breaker *Ledokol 2,* and the merchant steamer *Betty;* and the Swedish party in two—the ice-breaker *Svensksund* and the steamer *Rurik.* Toward the latter part of June, 1899, all the members of the joint expedition assembled at Tromsö, and on the 25th of June the five vessels set out for Spitzbergen.

Upon arrival there it was decided to divide the geodetic work

into two portions, the Swedish party undertaking the northern part of the triangulation which extends from the northern extremity of the arc down to Thumb Point and embraces 13 stations, and the Russian party occupying themselves with the larger triangles which are formed by the remaining 10 stations to the southward.

The western escarpment of the submarine elevation which culminates in the archipelago of Spitzbergen is due to the folding of ancient geological formations throughout a zone which passes from the Hebrides and Shetland Islands across the western edge of Norway and, going past Bear Island, continues to the westward of Spitzbergen. It is for this reason that the western part of the archipelago is characterized by mountainous ridges running parallel to each other and having serrated crests and isolated peaks reaching altitudes of 1,200 meters in one ridge and more than 1,700 meters in another. In the interior of the archipelago the conditions are quite different from those prevailing in the western part. All that part of the country which bounds the two sides of Stor Fiord and Hinlopen Strait is made up of horizontal strata. Indeed, the greater part of Spitzbergen is occupied by plateaux, and, if its discoverers had found its eastern instead of its western part, it is not probable that they would have bestowed its present name. From the interior plateau, which is almost entirely covered with ice and from which several isolated mountains rise up, enormous glaciers descend seaward both toward the east and the west.

The difficulties of making precise instrumental observations in the field were vastly increased by the extreme features of the climate, the dangers of travel, and great labour of transporting the heavy instruments, the tents, and the supplies of food, upon sledges or upon the backs of men, up the steep slopes to the stations, where, enshrouded in ice and storm, the observers would wait for weeks and weeks for the period of clear, transparent atmosphere that was sure to follow, sooner or later, to enable them to secure their observations.

The Swedish winter quarters were established at Treurenburg Bay, near Mt. Hecla, and the Russian winter quarters on the eastern shore of Horn Sound. At these places were installed the instruments that were needed for the observation of the magnetic, meteorological, and other phenomena that require continuous registration.

The base-line measured by the Swedish party was near the Swedish winter quarters, on the flat lying between Treurenburg Bay and Hinlopen Strait, and extended for a distance of about 10,000

meters in a direction nearly parallel to the general trend of the network of Swedish triangulation. The Russian base-line was measured on the eastern shore of Stor Fiord in the southwestern part of Edge Island and extended for a distance of about 6,200 meters through a marshy valley nearly at sea-level. Both bases were measured with a high decree of precision by Järderin's method with Invar tapes, in which the coefficient of expansion is very small.

Latitudes were determined at all the triangulation points and at six other stations, making twenty-nine determinations in all. This will provide one astronomical latitude for each nine minutes of the measured arc, so that an unusually exact study of the surface form will be practicable. Twenty-three azimuths were determined, and the influence on astronomical observations of the attraction of adjacent land-masses was ascertained. Pendulum experiments for the measurement of the intensity of the force of gravity were also made at selected stations. A map of the region traversed is forthcoming on a scale of 1/200,000, and special maps of the surroundings of the triangulation stations on larger scales. The general map will consist of five sheets, and three of these will be prepared by the Russians.

The scientific results of the expedition are being published in the French language in a series of mémoires. They are separated into two principal divisions, one for each nation; and comprise the following subjects:

TOME I: ASTRONOMY AND GEODESY.

Section I. History of the Expedition.

II. Geodetic Operations.
- A. Base-line measurements.
- *B. Measurement of horizontal and vertical angles.
- C. Adjustment of triangulation.

III. Astronomical Operations.
- A. Determination of time.
- B. Determination of azimuths.
- C. Latitudes.
- D. Longitudes.

IV. Intensity of the force of gravity.

*V. Tidal observations and precise levelling.

VI. Results of the combination of the geodetic and astronomical observations.

TOME II: TERRESTRIAL PHYSICS, METEOROLOGY, NATURAL HISTORY.

Section VII. Terrestrial Magnetism.
- *A. Magnetic Survey of Spitzbergen.
- B. Observations of variations of the magnetic elements.

VIII. Meteorology.
- *A. Regular observations at the winter quarters.
- *B. Solar radiation.
- *B^{i}. The state of the ice and snow.
- *B^{ii}. Forms of the ice-crystals.
- *B^{iii}. Meteorological observations made at the mountain stations.
- *B^{iv}. and B^{v}. Meteorological and hydrographic observations made at sea.
- *C. The aurora borealis.

IX. Topography and Geology.
- A. Topographical description of the region explored.
- B. Geology.

X. Botany.

A number of the Swedish mémoires have already been received in this country, and are marked by asterisks in the foregoing list. While working separately for publication in all else, it has been concluded that the commissions shall work together in the reduction of the final results of the four years' work, involving a comparison of the astronomical and geodetic results.

THE ANGLO-RUSSIAN AGREEMENT AS TO TIBET, AFGHANISTAN, AND PERSIA.

BY

ELLSWORTH HUNTINGTON.

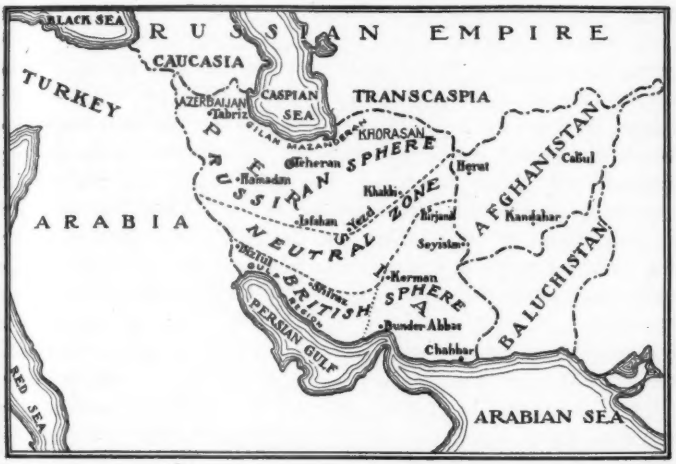
On September 25th, the British and Russian Governments published the text of a convention as to the sphere of action of each of the two countries in Persia, and as to their relation to Afghanistan and Tibet. The convention does not attempt to interfere with the

present degree of independence enjoyed by the three Asiatic states, but the result will almost certainly be a curtailment of the powers of the Shah of Persia. In Tibet and Afghanistan the convention does little more than confirm the status quo; in Persia it formally recognizes the hitherto disputed fact that Russian influence is supreme in the northern two-thirds of the country and British influence in the southern third.

Specifically it is agreed that Tibet shall remain intact and that neither Great Britain nor Russia shall interfere with her internal affairs. Whenever it is necessary to communicate with her they shall not send representatives to Lhassa, but shall carry on all business through the Chinese Government. Nevertheless the British Government may have direct relations with Tibetan officials through trade-agents, as provided in the conventions of 1904 with Tibet and of 1906 with China. Moreover, Buddhist subjects of both England and Russia may enter into direct relations with the Dalai Lama or other Buddhist functionaries in regard to strictly religious matters. Neither of the contracting Governments shall seek any concession for railways, roads, telegraphs, or mining rights. Put boldly, the meaning of the convention is merely this: Tibet is so inaccessible and poverty-stricken that Russia has no interest in her save as a place of pilgrimage for Russian subjects in southern Siberia, and as a vantage-point from which to inflict pin-pricks upon England. Therefore Russia abandons all claims except one in favour of her pilgrims. The British, on the other hand, have little or nothing to tempt them into Tibet unless it be the gold mines; but the advantages of working these are so doubtful that the possibility of utilizing them can be given up without sacrifice. A considerable number of pilgrims and an insignificant amount of merchandise pass between India and Tibet. The safety of these is provided for.

Afghanistan is more important than Tibet. She is independent so far as internal administration is concerned; but the British Government pays the Amir an annual subsidy, and in return therefor exercises suzerainty over the country and controls her foreign relations. In the new convention Russia formally recognizes Great Britain's suzerainty and agrees to have no dealings with Afghanistan except through the British Government. She will cease to fill the country with secret agents, hitherto a source of continual friction; but in return for this she exacts from England the assurance that the latter will not incite the warlike Afghans to take threatening measures against Russian possessions. Great Britain adheres to the Cabul treaty of 1905 and will not annex or occupy any part of

Afghanistan, nor interfere with internal affairs, provided the Amir shall fulfill his engagements. Commercially England and Russia are to be on an equal footing. If commercial agents hereafter prove to be necessary, the two powers shall come to an agreement over the matter, due regard being had to the rights of the Amir. The most important parts of the country, the region around Kabul and the populous valley of Kandahar, are much more closely related to India than to Asiatic Russia. The easiest routes run to India and practically all the trade is naturally in that direction. Therefore Anglo-Indian influence should be paramount. The pugnacious Afghans, being mountaineers with the hardiness characteristic of such people, and dwelling in a maze of almost impassable mountains, have proved



almost unconquerable, and England cannot hold them in check without an enormous waste of men and money. Therefore Afghanistan remains as an independent "buffer" state. Thus far the convention conforms fairly well to geographic conditions. There are serious discrepancies, however. In the first place Herat and the northwestern parts of the country lie entirely open to Transcaspia and all their trade flows thither. Russia must have constant contact with this part of Afghanistan, and where there is contact friction will arise, or else the Afghans will look to the Russians for protection and will forget the far-away Amir and his Anglo-Indian allegiance. Secondly, the Afghans are such wild people that England cannot guarantee that they shall not rise in arms against either herself or

Russia. If against the latter, it might seem to the Russians as if England, though blameless, had broken the convention. Finally, the rivers which water the Transcaspian oases of Tejen, Merv, and various minor places rise in the mountains of Afghanistan. More than once in the past the Afghans have diverted the headwaters of the streams and have thus opened the way for violence. In dry seasons this is almost certain to happen again unless Russia holds Herat and the Afghan mountains north of the main watershed.

The most far-reaching part of the Anglo-Russian convention concerns Persia. That country is at length divided into three parts. The first lies north of a line drawn in a great southward-bending curve from Kars-i-Shirin on the western boundary 100 miles northeast of Bagdad southeastward over 500 miles to include Isfahan and Yezd, and then northeastward nearly 300 miles to include Khakhi, and then still northeastward 250 miles farther to Zulfagar at the corner where Persia is joined by Afghanistan and Russia. North of this line in an arc larger than Austria-Hungary, Great Britain agrees that she will not seek for herself or for her own subjects or those of a third power any political or commercial concessions, and will not, either directly or indirectly, oppose any requests for concessions having the support of Russia. A second line runs from Bunder Abbas at the southern end of the Persian Gulf northward for about 200 miles to Kerman, then east of north another 200 miles to Birjand, and finally 100 miles east through Gazik to the Afghan boundary. In the area to the east of this—only half as large as the preceding, and for the most part worthless desert except at Seyistan—Russia gives a corresponding pledge to regard British rights. As to the intervening portion of Persia—an area of over 200,000 square miles, midway in size between the two preceding divisions, and about equal to France—both countries agree not to oppose the granting of concessions to subjects of either country. Existing concessions are to be maintained. At first sight it appears that Russia has obtained very much the best of the bargain. She has, however, given up Seyistan, the half-way house to India, and—a matter of much greater importance—she has given up her long-cherished dream of a railroad running south near the eastern border of Persia along the easiest of all possible lines to Bunder Abbas, Chahbar or some other port of Makran on the Arabian Sea.

Sir Edward Gray, British Foreign Secretary, in issuing the text of the convention, added a special letter to the effect that the agreement does not affect the regions around the Persian Gulf. These are regarded as not pertaining to the Anglo-Russian frontier problem,

and, therefore, as needing no positive declaration with respect to Britain's special interests in the Gulf which are the outcome of her action in those regions for 100 years. The status quo will be preserved and British trade fostered, but Great Britain does not desire to exclude the trade of any other Power. If Russia really accepts Sir Edward's view, which is extremely doubtful, she has indeed made a great concession. She has relinquished one of her dearest projects, the plan for an outlet to the Indian Ocean.

Assuming that Russia accepts or is obliged to accept the English view, Persia from now on will consist of three divisions. The northern division, forming the Russian sphere, is shaped like a rude, blunt-ended crescent, nine hundred miles wide from tip to tip and 250 miles thick. It contains the best parts of Persia: Azerbaijan, the rich northwestern province, which is the granary of the country, and the only region to be really desired by Europeans; Gilan and Mazanderan, hot, steamy districts of great wealth and beauty on the southern shore of the Caspian Sea, but unfortunately cursed with a most unhealthful climate; and Khorasan, the great northeastern province, next to Azerbaijan in wealth. Besides these more favoured regions it includes a more southerly tract. The western part of this consists of mountains full of Kurds and other nomads and supporting at their base some of the chief cities of Persia, such as Teheran, Hamadan, and Isfahan. The eastern part is for the most part a desert plain, the saline centre of a vast inland basin.

The second division of Persia is likewise a blunt-headed crescent, 900 miles from tip to tip and averaging about 125 miles thick. The eastern half consists of practically nothing except the most inhospitable desert, a place to be avoided when at its best in the late winter, a fiery furnace where all the water is saline and men die of thirst in summer. The western half consists of rugged mountains only to be crossed with great difficulty, dry and barren to Western eyes and yet supporting bands of turbulent nomads, the Suris and others.

The southern or British division of Persia is a little better than the central division. That is the best that can be said of it. In the northern part of the broad eastern end it contains fertile Seyistan, which the natives call "a hell full of bread." In the centre is the dried-up city of Yezd; then, in the narrowing western end, Shiraz, for ages the theme of poetic extravagance; and finally at the far northwest the potentially rich border of the Mesopotamian plain and the Karun River to Dizful. The rest of this division is either desert or trackless mountains, with only a handful of people. Almost the only value of England's portion, aside from possible mineral

wealth, lies in the command of the Indian Ocean which it assures to that country.

It would be premature to say that Persia has been divided, but a long step has been taken towards that consummation. The convention provides that, in case of the non-payment of interest on certain debts already contracted through the official British and Russian banks of Persia, either of the signatory Powers may take over the customs service and administer it in favour of the creditors. This provision, which on its face appears of minor importance, may lead to actual, though unavowed, partition of the Shah's domain. Persia is not in the habit of paying its debts. If the entire customs service, as well as the concessions for railroads, mines, and so forth, is divided between the foreign Powers, small autonomy remains to Persia.

Some one must eventually exercise control over the unassigned "buffer" which England has left between herself and Russia, and the two countries must eventually agree upon a common frontier. It is perhaps not unreasonable to suppose that ere many decades England will concede northwestern Afghanistan to Russia in return for fuller rights in southwestern Persia around the Persian Gulf. When that is accomplished many causes of friction will vanish; for the political boundary will coincide with a somewhat pronounced physical boundary—on the east, the central mountains of Afghanistan; in the centre, the deserts of eastern Persia; and on the west, the high mountains of western Persia.

EXPERIMENTAL PHYSIOGRAPHY.

BY

GEORGE D. HUBBARD.

A beginning in experimental physiography was made at Ohio State University* during the past year. A basement room in the geologic building was fitted up with drains, bins of sand, clay, cement, and various other materials, and river and ocean tanks, for running and standing water. The first problem chosen was that of the aggrading and degrading stream, not so much to discover

*The author was ably assisted by Mr. A. E. Moody, an advanced student in the department, to whom thanks are due for many suggestions.

new laws as to test book knowledge and to compare the controlled experiment with the processes in nature's laboratory. The student's growth and the results obtained fully justify the outlay of money, time, and thought. And, further, some new things have been seen in miniature which ought now to be verified in the study of the life-size forms in nature.

The Initial Valley.

Into a water-tight tank two feet wide, sixteen inches deep, and eighteen feet long was put by hand a weak concrete to form a mature valley. The general trend of the valley was straight, but the line of greatest depth was made to swing from side to side by constructing spurs of the weak cement alternately from the opposite sides of the valley. This piece of construction occupied all but eighteen to twenty inches at each end of the tank, portions which were left, at the upper end for a clay depository and at the lower end for a lake basin around the outlet. The lower end of the tank was fixed on a substantial block, while the upper end rested on a twelve-inch steel jackscrew, so set that the slope of the tank could be varied from zero to one foot in seventeen, or about 3¼°, equivalent to three hundred and ten feet per mile. To begin with, the valley was given a slope of one inch in seventeen feet, or about 26 feet per mile.

Aggradation.—Dry fire-clay of unequal fineness was heaped into the upper end of the tank above the valley and the finest spray obtainable from a garden hose was turned on. The clay was washed down the mature rock valley, and with it the stream aggraded the valley. Progress was so slow on account of the coarser clay and the stream that we were obliged to use, that we steepened the slope to two inches in the length of the valley. With this slope, aggradation proceeded more rapidly, and the valley was filled level full at the upper end and nearly so at the lower end. In order to complete aggradation, we raised the level in the lake at the outlet at about the rate the valley was aggraded, by lengthening a perforated stopper.

Degradation.—When a satisfactory stage of filling had been reached no more clay was added, and the stream's burden became so light at the source that it began down-cutting. No change was made in slope or water supply except as water-pressure varied, but degradation continued until a youthful valley, with an interesting series of terraces, was carved in the flood-plain, and the stream touched the rock-bed of the valley at many points.

This completed the experiment, which had occupied a winter

term of thirteen weeks. Three photographs were taken—one near the beginning of the aggradational work (Fig. 1), one just after degradation had begun (Fig. 2), and one at the completion of the experiment (Fig. 3). These are introduced into the text and show the general features of each phase in the experiment.

FIG. 1.

RESULTS OF THE EXPERIMENT.

Aggradation Fans.—It is particularly the results of our work that I desire to present. While the aggradation process was going on, two peculiarities of the method attracted our attention. The first of these was the making of an asymmetrical, fan-like feature on the flood-plain. While the stream was flowing in its channel, it

gradually deposited on the inside of a curve until the channel became choked, and the stream, being pushed over the opposite bank, was forced to take a new course. It then proceeded to construct a systematic asymmetrical fan over previous flood-plain deposits, and finally again came to flow temporarily in a rather definite channel across the fan. The latter possessed a very gentle slope, which seems much exaggerated in the photograph. Almost immediately after the establishment of a satisfactory channel, the deposition on the inside of curves would again begin and the entire process would be repeated. So constantly was this process in operation that there was always at least one such fan under construction in the fifteen or sixteen feet of flood-plain, and not infrequently three or four were building. The photograph (Fig. 1) shows a number of them. So numerous were they that at times they constituted about the only forms of accumulation. They are probably a feature of the more rapidly-flowing streams, and not of such as the Mississippi. They overlapped each other in part, and might have furnished excellent miniature illustrations in section of cross-bedding. Our clay was all so similar, and so little consolidated in the flood-plain, that sections cut through the strata did not reveal the interval structure.

Pits or Depressions.—The second peculiarity was the formation and preservation of pits or depressions on the flood-plain. Frequently, beneath eddies at angles in the stream or at the junction of two channels, a pit an inch deep or less would be dug out, and subsequently, when the stream withdrew bodily from its shallow, ill-defined channel, the pit would remain unfilled (Fig. 1 and Fig. 2). A depression one-half inch deep and one to two and one-half inches across is a small feature, but in an aggradational flood-plain less than a foot wide it is very conspicuous. It seems probable that this pit-making process may have been operative on outwash plains in some of the larger valleys of central New York and adjacent Pennsylvania. Many so-called kettles in the Susquehanna and Chemung gravel-plains now persist as pits, sometimes as swamps. A detached ice block is supposed to have been buried or surrounded with outwash gravel, and then to have melted out, leaving a kettle-like depression in the gravel. But if our experiment was analogous with nature in this particular, nothing more than the normal pit-forming process of overloaded streams need be called in to explain such kettles. Following the habit of those in glacial valley plains, our kettles would not retain water, until muddy water had soaked down in them several times, leaving a film of fine clay to plug the interstices between the coarser clay-pieces. Both of these peculiarities

are little known in the field, and further observation must be made to determine whether they arise from the peculiar conditions of the experiment or are normal in aggrading streams.

FIG. 2.

A Cause for Stream Migration.—In confirmation of the excellent study of Mr. R. F. Griggs* these experiments showed that the stream, by depositing sand bars in its channel on the inside of its curves, forces itself to cut on the outside and thus to enlarge its meander curves. This, as it is well known, is not the only cause of meanders, but is one of several causes. It seems to be more effective in streams of moderate velocity. Rapid streams, after making

*BULLETIN, Amer. Geog. Soc. Mar., '06. Vol. XXXVIII, pp. 168–177.

a bar, push it away and re-straighten their courses, and the more sluggish ones are turned aside by many slight obstructions. Further evidence of the marked influence of "overload" upon meandering appeared when the clay supply was withdrawn. The stream thereafter made substantial progress in straightening its course, and soon for several feet it ran in a "bee line," until in its down-cutting it found the spur ledges and was obliged to turn aside.

Slope, Water Supply and Load.—Slope and water supply have been considered the chief factors that determine whether a stream shall aggrade or degrade. Our experiments demonstrated clearly that there are three factors entering into a stream's habit—viz., slope, water supply, and waste supply or load. As long as our miniature river was kept supplied with waste (all it could carry) it continued to aggrade. We left the slope the same so far as the tank was concerned, throughout all the experiment, save while experimenting the first few days, as described below, and kept the water supply fairly constant. With these constant variations in the supply of waste varied the habit of the stream. An abundance of clay always gave an aggrading stream, but as soon as the supply of clay was cut off the stream began to degrade. We temporarily increased the slope; but, as long as the clay supply was abundant, the stream persisted in aggrading; then we temporarily increased the water supply, and, as long as the larger volume found abundance of clay to carry, the stream's habit remained unchanged. It aggraded. Having abundance of waste within reach of the stream, we decreased the water volume. This did not increase deposition, but rather decreased it, because with diminished volume came diminished velocity and carrying power, hence the stream could not pick up as much as formerly. It was still loaded to the maximum, but the maximum did not mean as much clay as with greater volume. Then we decreased temporarily the slope, which, though often stated to increase deposition, in this instance actually decreased it because the stream was then unable to start so much material as formerly, and, of course, had less to drop. Our stream did all its aggrading and then all its degrading, with no change either of slope or volume, save those just mentioned, but solely a change in clay supply.

The conclusions concerning the relative importance of slope, water supply, and load and their relation to the habit of the stream (aggrading or degrading) may be summarized as follows:

A stream having access to abundance of rock waste will aggrade faster with increased water supply and also with increased slope, and will aggrade more slowly with decrease in either water supply

or slope. But an underloaded, hence a degrading, stream if supplied with more waste may be made to aggrade with neither decrease in slope nor in water supply; or may be made to aggrade by decreasing water supply or slope, thus reducing carrying power below the load. Habit is a matter of adjustment or balance of the three factors; and the habit is changed in a stream with changes of slope or water

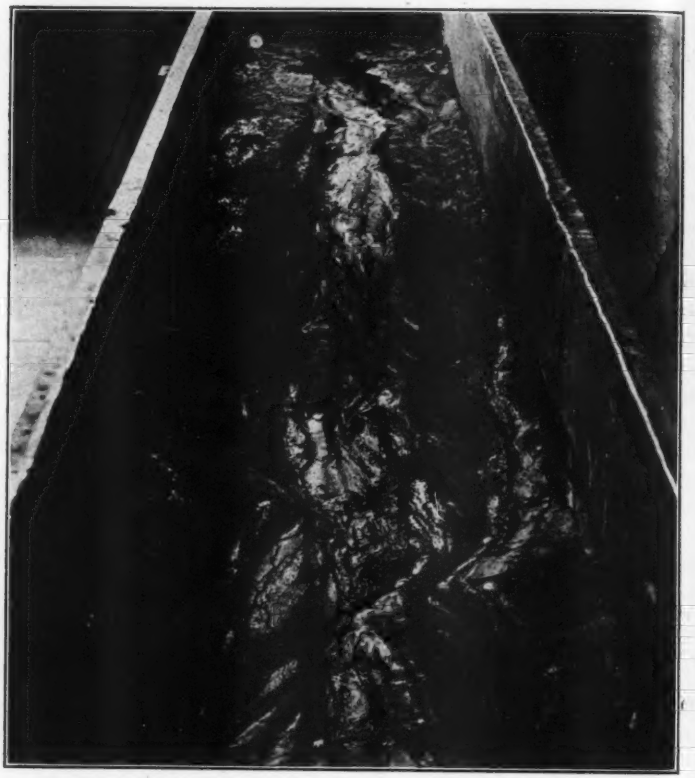


FIG. 3.

supply (1) when the clay supply is abundant to overloading, (2) when clay supply is very insufficient. But in the first case changes are simply quantitative, while in the second they are qualitative.

Double Channels.—When aggradation was stopped by cutting off the supply of aggrading material the stream forthwith began degrading. In places there were two or three channels—a braided

course—but in each the stream excavated a channel, and thus there came to be not only terraces along the valley sides, but remnants of the flood-plain with lower new flood-plain all around. Ultimately the stronger stream gained the mastery and took all the water, leaving a deserted channel through the plain only a little above the one occupied by the stream.

I had tried to account for this feature when observed in the present valley of the Susquehanna in southern New York, and am now satisfied that it may be explained as illustrated by our experiment.

Preservation of Terraces.—In striking confirmation of the explanation so carefully worked out by Prof. Davis for alluvial terraces standing above present flood-plains, the experimental river carved series of terraces as it gradually entrenched itself in its bed of deposits, but subsequently cut out most of them which were not defended by rock spurs (compare Fig. 2 and Fig. 3). Not all terraces remaining to the end of the experiment were behind or above rock points, but none that were removed by stream undercutting were tipped with rock. At the end only an occasional terrace remained which had no rock defense, but possibly if more time had been allowed all remnants within reach of the stream would have disappeared. The defense was a very evident feature in every extended series of terraces; but a few single or two-step terraces unprotected still remained. Certainly chances for their permanence were very few.

Terrace Persistence Down Stream.—Very soon after degradation began it was noted that the terraces were not persistently at the same height above the new flood-plain, but that they seemed to come in strong and run out down stream (Fig. 2). This is an expectable phenomenon, because the stream, now degrading, was continually reducing its steepness of slope. Its highest aggradational plain and the flood plains at subsequent lower levels were not parallel. Degradation being more rapid upstream, each terrace must decrease in height and then run out, when the plane of any new flood-plain met downstream with the plane of the top aggradational plain or any previously formed flood-plain. And where the planes of any two flood-plains intersected, the terrace between them would be shallower until it finally ran out.

In Conclusion.—The experiment served to call attention to several things rarely or never seen on larger flood-plains. Things concealed by their smallness in comparison with the larger and more commonly seen features have been brought out and emphasized. It must not

be forgotten, however, that some features seen may be peculiar to a stream in clay loosely laid, but would not be found in nature. Field work is now necessary to verify some of these purely observational points, and, until so verified the latter may be considered as facts belonging to the experimental stream, but not necessarily to all streams whether free or not.

OHIO STATE UNIVERSITY.

ANGELO HEILPRIN.

Professor Heilprin died in New York city on July 17th last. Born in Hungary in 1853, he was only 54 years of age. He was in the prime of life, and his enthusiasm for scientific research and joy in the life-work he had chosen had suffered no abatement. Though his reputation as a geographer and naturalist was international, his untimely loss is felt with especial poignancy at home.

Heilprin came of a talented family. His grandfather, Phineas M. Heilprin, was a recognized authority in Hebraic and philosophical literature in the early part of the last century. His father, Michael Heilprin, was an erudite scholar and held a high position in the fields of Biblical interpretation and literary criticism. Michael Heilprin and his family came to America in 1856, and in 1860 young Heilprin's education began in a public school of Brooklyn. The boy was precocious; his passionate love of knowledge and his facility in acquiring it were innate. His intellectual tendencies and talent were fostered and promoted by his home training, and while still in his teens his receptive mind had embraced a wide range of knowledge. Mr. Louis E. Levy, in the *Memoir* read before the Franklin Institute of Philadelphia in September last, wrote that before young Heilprin had reached his twentieth year he was a capable associate with his elder brother Louis in the work of their father as revising editor of the American Cyclopædia, contributing also a number of original articles, notably the biographical sketch of John Tyndall.

The year 1876 found Heilprin in London studying the natural sciences at the Royal School of Mines with Huxley as his guide in biology, Ethridge in palæontology, and Judd in geology. The young man received the Forbes Medal for proficiency in biology and palæontology. Later he studied in Paris; wandered on foot

through the Swiss Alps, learning what he could of their glaciers; spent eight months in Geneva at the lectures of Professor Carl Vogt and among the collections of the Natural History Museum. Still adding to his stores of knowledge, he made prolonged journeys in the Tyrolese Alps, Austria, Hungary, and Russian Poland, and then returned to America. His three years in Europe had greatly developed his gift of critical and accurate observation.

He was twenty-seven years old when he began his life of incessant productivity. Forming a connection with the Academy of Natural Sciences in Philadelphia, he made his permanent residence in that city. He became professor of invertebrate palæontology and later curator in charge. His relations with the Academy continued until his resignation in 1892.

Late in the eighties, Heilprin began the series of scientific explorations that so greatly distinguished his career. In 1886 he led an expedition to the Everglades of Florida, and his studies of that interior region and of the fauna of the seashore were rich in scientific results. Almost simultaneously with the publication of his elaborate report on the Florida explorations came his book "On the Geographical and Geological Distribution of Animals," a volume of the International Scientific Series, which retains its place as a standard work on zoögeography. Before the eighth decade closed Heilprin published three more books which enhanced his reputation: "The Animal Life on Our Seashore," an attractive and popular presentation of the subject; "The Geological Evidences of Evolution," and "The Bermuda Islands." In 1890 his "Principles of Geology" elucidated the subject by means largely of photographic reproductions from nature; the first extensive use of this method of illustration. Heilprin was one of the first to appreciate the educational posibilities of the new art of half-tone photo-engraving.

His visit to the Mexican plateau in 1890 helped to determine the true nature of that wonderful natural feature and establish the fact that Orizaba and not Popocatepetl was the highest point in Mexico. He continued these studies in 1906 and was preparing a volume on the subject at the time of his death. Among his other conspicuous labours in the field were his glacial studies in the Arctic regions on some of the Peary expeditions. His appreciation of Peary's work and his active friendship were of the greatest service to that explorer in his undertakings.

Heilprin visited Alaska in 1898 and 1899, and recorded his observations in his book on "Alaska and the Klondike." His remarkable

studies of the Martinique volcano, La Montagne Pelée, were the result of three visits to the island; and in 1906 he was able to gratify a long-cherished desire to see the wonders of the tropical forests by a journey into the interior of British Guiana. It was there that he contracted the fever which undermined his constitution and prepared the way for his untimely end.

In 1886 he organized the Geographical Society of Philadelphia and was long its president. Together with his brother Louis he gave much of his time for five years to the arduous task of reconstructing "Lippincott's Gazetteer of the World." In 1903, Yale University called him to direct the Department of Physical Geography in the Sheffield Scientific School. During his career he was highly honoured by various scientific societies, and at the time of his death he was President of the Association of American Geographers, Vice-President of the American Alpine Club, Associate Editor of the BULLETIN of the American Geographical Society, and he held prominent positions in several other societies.

Professor Heilprin was a man of brilliant intellectuality and restless activity, who accomplished great work in a brief space of years. The list of his published writings would be a long one. He had the respect of all men not only for his fine achievements but also for the simplicity of his character, his modesty and gentleness and his great desire to be helpful not only in widening the bounds of knowledge, but also in disseminating the truths of science more generally among his fellow-men.

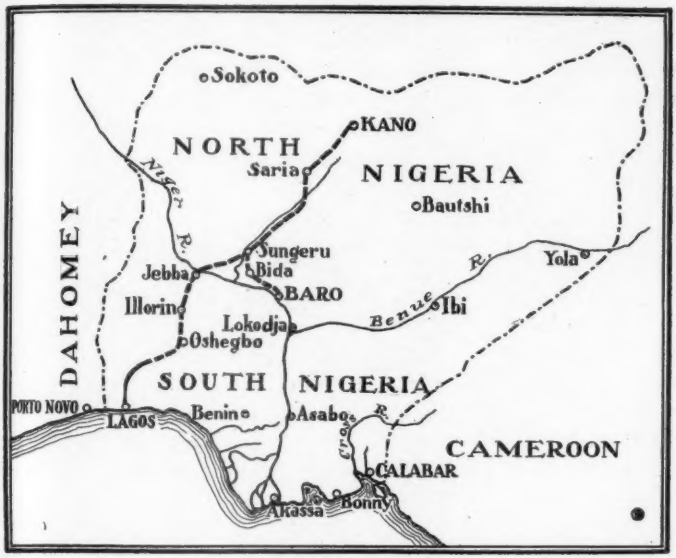
A RAILROAD THROUGH NIGERIA.

Several months ago an American who has lived in Nigeria said in New York that the climate and soil of that large region are favourable for the cultivation of cotton, but as yet there is no encouragement to raise it because there are no railroads to carry it to the sea. Cotton, being a bulky and low-priced commodity, cannot be carried to a distant market except at cheap rates, and only railroads to inner Africa will supply the cheap transportation required.

This railroad is now to be supplied. It is to start from Baro on the Niger River below the rapids that impede navigation. Vessels loaded with cotton brought by rail to Baro may descend the

Niger to Akassa, the port at its mouth where steamships may load the freight for Europe. The northern terminus of the railroad will be Kano, the great and populous capital of Hausaland, some 500 miles from Baro by rail and not far south of the Sahara Desert. Kano became known some sixty years ago as the greatest manufacturing and commercial centre of the western Sudan. It is expected that the railroad will largely increase its importance.

The British Government authorized the building of the railroad in August last. Its gauge is to be 3 feet .6 inches. Sir Percy Girouard is to superintend the work, and his former achievements



RAILROADS IN NIGERIA.

as a constructor of railroads in South Africa seem to show that he will do his task well. The line is to reach Sungeru at the end of 1909, Saria in 1910, and Kano in 1911. It will cost about $6,000,000, and will be of enormous benefit to the people of Northern Nigeria and also of advantage to England in two principal ways. It will be of much strategetical and administrative importance, and will offer a ready means of transporting the cotton crop, which promises to increase very rapidly in the future.

But Kano will be joined with the sea not only by this railroad and the Niger but also by a through rail route by way of Jebba and

Lagos. The South Nigeria Railroad is to extend from Lagos to Sungeru in Northern Nigeria. Our map shows the unbroken part of the line from Lagos, indicating the section of this railroad now completed. It is being pushed forward with energy, will attain the Niger at Jebba within less than a year, and in eighteen months trains will be running to Sungeru, where they will connect with the North Nigeria Railroad.

A bridge will be thrown over the Niger at Jebba, but all effort will first be devoted to completing the railroad, and trains will be ferried across the Niger until the bridge is completed.

These enterprises are significant, for they are certain to be great factors in the development of very promising parts of West Africa. Lagos is now the largest commercial centre on the Atlantic coast of the continent. An agricultural fair in that city recently testified to the importance which farming interests are already attaining. Many native farmers were among the exhibitors, and such exhibitions are regarded as having important educational influence upon the natives.

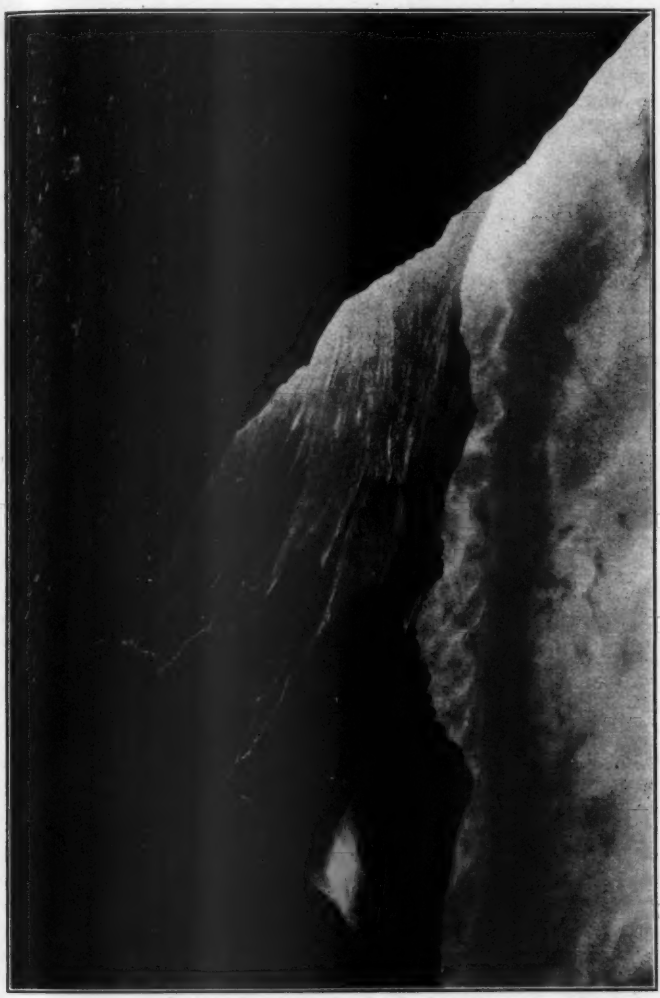
THE SOURCES OF THE RHINE.

This photograph, produced in *La Montagne* (No. 7, 1907), shows the head streams of the Rhine. These little brooks, far up on the slopes of the Adula Mountains, unite to form the Hinter-Rhein or Further Rhine. They are filled with purest glacial water, and we see in the picture the snow and ice extending down the mountain slope a little way below the glaciers that are the perennial fountainhead of the great river.

This mountain slope is a part of the hydrographic centre of the Alps. The eastern and northern slopes of the Adula group send their glacial streams to the Rhine. The drainage of the western slopes reaches the Ticino River and has its outlet in Italy. A little to the west, the heights around St. Gotthard contribute water both to the Rhine and the Rhone systems.

Many other lofty glaciers besides those of the Adula group are feeders of the Rhine. This is the reason why the Rhine is the most useful of all the rivers flowing through Germany. Its facilities for navigation, its great wealth of water, and its exceptional depth make it the most important among the German rivers. In summer, when other rivers, excepting those of the Danube system, shrink greatly

in volume, the Rhine is still copiously fed by the melting of the Alpine glaciers.



THE SOURCES OF THE RHINE.

Reclus says that the Rhine, rising on the slope of the Adula, drops through a chaotic mass of rocks rejoicing in the epithet of "hell." Lower down it traverses many another "hell," th.. most

famous among which is the fearful gorge of the Via Mala, bounded by precipitous rocks rising to a height of 1,500 feet. Just below that famous cleft in the mountains where the river is confined to a bed hardly thirty feet wide the Rhine is joined by two mountain torrents. One is the Una, whose waters are sometimes as black as ink owing to the triturated slate which they hold in suspension. The other is the Albula or White River, which issues from a gorge, hardly less wild than that of the Via Mala. The Rhine, now an imposing river, is rapidly increased in volume by other tributaries, flows through a wide, alluvial plain, and then enters the ancient lake-basin now nearly filled with alluvium, in which it passes on to Lake Constance.

GEOGRAPHICAL RECORD.

AFRICA.

CLIMATE OF EGYPT.—Egypt may be divided climatologically into the following four regions:

1. The North Coast and the Delta.
2. Middle Egypt down to latitude 27° N.
3. Upper Egypt and the Northern Sudan as far south as latitude 18° N.
4. The rest of the Sudan to latitude 5° N. The Red Sea littoral and the country south of latitude 10° form two divisions.

The first region depends for its climate on proximity to the Mediterranean, and is much affected by the storms of that sea. The prevailing wind is the northeast trade, which here blows rather from the northwest. Storms passing to the north bring south winds, followed by comparatively abundant rain in winter and spring.

The second region forms a transition belt between the first and third. It is near enough to the Mediterranean to feel the influence of the prevailing weather there, but is chiefly influenced by the presence of the desert on both sides.

The third region is beyond the influence of the Mediterranean weather, and is entirely controlled by its proximity to the desert. The northeast trade blows uniformly all the year, and south winds are almost unknown. Rain is limited to occasional falls in thunderstorms.

The fourth region is affected in summer by the monsoon of northeast Africa, but for the rest of the year lies in the belt of the northeast trades. It thus suffers a regular seasonal alteration of weather, dry northerly winds prevailing for rather more than half the year, while moist southerly winds, accompanied by copious rain, blow for the remaining portion.—(*Survey Dept. Egypt. Met. Rept. 1904, Pt. II.*) R. DEC. W.

LONG-RANGE FORECASTS FOR SOUTH AFRICA.—Mr. D. E. Hutchins, Conservator of Forests for South Africa, has made a careful study of the rainfall

records of South Africa with a view to determining a periodicity in the rainfall. Three cycles have been considered—the solar, of 11 years; (2) the Brückner, of 35 years; (3) a storm cycle, of 9.5 years and a Meldrum cycle, of 12.5 years. Mr. Hutchins recognized these cycles in 1888, and predicted the rainfall of that year by means of them. Since then they have, with few failures, agreed with the rainfall of subsequent years. He concludes that (1) the three main weather cycles are of general application east and west beyond their areas of maximum influence; (2) on going northward the heavier rainfall occurs a season earlier; (3) there are obscure indications of a tendency to rain at the sunspot minimum, but the normal minima have so frequently coincided with the other cycles that the exact influence of the sunspot minimum is difficult to trace, and further observations are necessary; (4) up to the present time the direct influence of the Brückner 35-year cycle is inappreciable in South African weather. R. DEC. W.

THE OKAPI ON THE WELLE-MAKUA.—In his recent journey across Northern Nigeria and the northeastern part of the Congo Free State, Lieutenant Boyd Alexander heard rumours of the existence of the okapi near Angu on the Welle-Makua, about 500 miles to the west and north of the region, where it had earlier been found in the eastern edge of the Congo forest. The animal is well known to the natives around Angu, but this is the only region near the Welle-Makua where it is met with.

Alexander's party spent three weeks in the effort to obtain a live specimen. The Portuguese collector, José Lopes, followed a solitary okapi for three successive mornings near a stream. He observed that on leaving the water the okapi always took the same course between two large trees about 100 yards from the stream. In his address before the Royal Geographical Society (*Geog. Jour.*, Aug., 1907) Alexander says that José, with the help of natives, dug a pit between the trees and carefully concealed it with branches and leaves. Early next morning he approached the stream and heard the okapi running away. The animal, taking its usual course, fell into the pit and was secured. It was impossible, however, to keep it alive. In the terrible struggle to reach the Nile most of the collections had to be thrown away; but Alexander clung to his beautiful okapi skin, which is being mounted and will be on exhibition at the Natural History Museum, London.

Alexander says that they found the haunts of the okapi along small streams running through swampy grounds and thickly overgrown with a clean-stemmed plant some six to eight feet in height, the young shoots of which are an essential food of the animal. Here it roams about singly or in pairs, and, according to the native hunters, three are occasionally found together.

Captain Gosling of the party managed to get near to the okapi on three occasions, but it was so perfectly concealed among leaves that he did not catch a glimpse of it. During the night the okapi wanders along in the mud and water in search of the young shoots of its favourite plant. It may be found feeding as late as 8 A.M., after which it retires to the seclusion of the forest and remains until dusk. Owing to the thick leaves and the forest, the restless nature and keen hearing of the animal, even the natives find it difficult to track it, and are obliged to resort to trapping. They regard the animal as a mysterious creature, and say that it is always moving and never lies down to sleep. The observations of José Lopes seem to confirm this assumption to some extent. On

several occasions when he heard it feeding, it simply paused to take a leaf here and there and then passed on again.

Sir Ray Lankester, discussing Alexander's paper, expressed the opinion that this region is probably the extreme western and northern range of the okapi. The skin which Alexander brought home, he said, differs from that which was brought by Sir Harry Johnston from the Semliki River, being of a very much darker colour and with stripes more numerous and of a creamy white rather than pure white. There are also features about the skull and the tufts of hair at the tail in which it differs from the first specimen. Nearly every specimen of okapi, in fact, which has been brought to Europe differs greatly from every other. Prof. Sir Ray Lankester said that it was one of the most variable animals that had come under his observation. He is examining, as far as he can, all the skins and skulls of the okapi that have been brought to Europe. He has studied thus far some twelve of the twenty specimens in Europe, and hopes eventually to be able to say something definite on the subject of this animal.

When Sir Harry Johnston brought the first specimen to Europe, it was classified as a new genus of *giraffidae*. In his "Uganda," Sir Harry Johnston said that, as far as was known in 1902, the okapi was confined to the northern part of the Congo forest near the Semliki River. Alexander's find, however, was far to the west. The okapi and the giraffe, it is thought, may be the two surviving forms of giraffe-like animals of which fossil remains have been found in Lower Egypt, Arabia, India, Greece, Asia Minor, and southern Europe.

Several allusions in earlier writings to a mysterious animal doubtless refer to the okapi. Passages in the early Dutch and Portuguese writers, for example, tell of a strange horse-like animal of unusual markings in black-and-white existing in the depths of the equatorial forests; and Stanley printed a note in "Darkest Africa" saying that the Congo dwarfs know an animal of horse-like appearance in their forests which they catch in pitfalls.

AMERICA.

The Geography of Bolivia.—At the end of September Mr. Isaiah Bowman, Instructor in Geography at Yale University, returned from an expedition to northern Chili and Bolivia. Realizing the importance of genuine geographic research as distinguished from mere travel, and feeling especial interest in South America, the authorities of Yale last spring gave Mr. Bowman six months' leave of absence for the prosecution of this work. Sailing by way of Panama, Mr. Bowman, accompanied by Mr. R. L. Rogers, reached Iquique in northern Chili during the latter half of April. Thence by rail and caravans the travellers went inland across the coastal pampa and over the western ranges of the Andes to the western border of the great lake which formerly filled the central basin of Bolivia, parts of which are now occupied by Lakes Titicaca and Poopó. They came back to the coastal region by a more southerly route, and after studying the great nitrate deposits which have been the cause of so much quarrelling between Peru and Chili, went south along the coast to Antofagasta. Taking the railroad at that point they once more crossed the western ranges into the great central basin. Here they made numerous excursions to the old shores of the lake near the railway, and into and across the eastern Andes. One such excursion was to Cochabamba and another to the eastern base of the Andes, where the upper waters of the Mamoré, a tributary of the Madeira

River, emerge upon the vast eastern plain of South America, over 1,600 miles from the sea, and only about 700 feet above it. Northwest of Lake Titicaca Mr. Bowman and his companion went on to old Cuzco, and then returned to the sea at Mollendo by way of Arequipa for the voyage home.

The specific object of the journey was the description of a certain portion of South America according to a definite geographic plan which involved the constant correlation of the physical features of the country with the habits, occupations, and character of the people. For instance, the presence of the nitrate deposits explains various unusual phases of human activity ranging all the way from the distribution of villages to the mode of life of the people and the politics of Chili, Bolivia, and Peru. Among the more purely physiographic problems studied by Mr. Bowman the most interesting are the plateau-structure of the region, which is plainly evident even among the highest mountains; the extent of ancient glaciers, the expansion of former lakes, and the evidence of changes of climate since the occupation of the country by man. E. H.

Snow-line, Glaciers and Climate in the Andes of Ecuador.—Dr. Hans Meyer has recently made a study of the snow-line, of the height above sea-level of the glaciers, and of the general climatic conditions of the Andes of Ecuador (*In den Hochanden von Ecuador,* Berlin, 1907), the immediate object of his trip being the investigation of the present conditions of snow and ice, and of the evidence of former more extended glaciation. Wilhelm Reiss, thirty years ago, determined the height of the snow-line on the Eastern Cordilleras as 4,620 meters, on the Western Cordilleras as 4,720 meters, and the mean for both ranges as 4,670 meters. Meyer shows that within the last thirty years the snow-line is at least 50 meters higher, so that the present height is about 4,700 meters and 4,800 meters on the two ranges. The average limit of glaciers twenty-five years ago was about 300 meters below the snow-line; now it is only 200 meters below the snow-line. The mean height above sea-level of snowfalls is 3,700 meters. Within the last thirty years the glaciers have retreated about 150 meters, and are still retreating. In the glacial period the glaciers extended down to about 3,800-3,700 meters, or 800-900 meters lower. That was a time of more abundant precipitation, and also of lower temperature (for Ecuador, about 5.5° lower).

On the west side of Cotopaxi the last cultivation of the soil (potatoes) was found at 3,765 meters. On the north side the highest habitations are at 4,266 meters. The Ecuadorian Andes are under the control of the easterly trade winds. The cirrus clouds move about the high plateau steadily from east to west. The Western Cordilleras alone have westerly winds during the day. These winds rise from the warmed Pacific lowlands and often reach up to the highest mountain summits, being replaced at night by easterly winds. Thunderstorms and rains come with easterly winds. In the dry season (*verano*) the clouds are driven across the Eastern Cordilleras and on to the inter-Andine plateau, where they are soon dissolved by the warm, ascending air. The broken clouds rise rapidly, under the control of the stormy trades, drifting across the plateau, and giving light showers (*paramitos*), apparently from a clear sky. The vapour condenses again on the Western Cordilleras, forming cloud-banks, which dissolve again over the western slopes. The cloud from the volcano Sangay (5,320 meters, Eastern Cordilleras) is carried by the trade winds off toward the west, like the smoke from a locomotive. From this smoke there is a steady fall of ashes over the plateau. The smoke cloud itself reaches a height of 5.5-8.5 miles. The smoke column from Cotopaxi during violent eruptions has been estimated and

measured at a height of 8.5 miles (five miles above the crater). The volcanoes are often capped with clouds.

Regarding the climate of Quito, Dr. Meyer says that it is characterized by burning sunshine during the day. There is a sudden cooling under cloud-shadows. Frequent rain squalls, with hail, even with snowflakes, are notable features. It is a climate of "colds." Everybody coughs. In the evenings a winter overcoat is the most comfortable garment. Meyer finds the principal cause of *soroche* (mountain sickness) in the decrease in the supply of oxygen in consequence of the rarity of the air. *Soroche* was experienced at night and especially above 5,000 meters.—(*Abstracted and translated from Met. Zeitschr., May, 1907.*) R. DEC. W.

ASIA.

THE HEJAZ RAILWAY TO MECCA.—The survey work of the Hejaz railway from Medina northward having been completed for a considerable distance, the actual work of construction has now begun on this section of the road. Ties, rails, and all other materials are imported to Yembo, on the Red Sea, whence they are carried on camels to sacred Medina. The Sultan, with customary ignorance of geographic conditions, has prohibited the sale of Government lands along the proposed line. He has ordered them to be reserved for the settlement of immigrants, to whom they will be leased for a nominal rental. Urgent orders have also been issued in regard to the planting of trees all along the line. It is said that, as a result of the Sultan's interest in the railroad, private landowners along the proposed course are reaping a rich harvest from the sale of their lands. Prices have risen marvellously. It is to be feared that the Sultan and the buyers will be greatly disappointed. Few parts of the world are drier and less inviting than northern Arabia. The projected restoration and repair of the Jubeda canal and other old waterways, both natural and artificial, will doubtless be a great boon to the country. Nevertheless, little can be expected of them; for canals are useless without water. The few travellers who have visited this part of the world agree in describing it as almost insufferably hot, and as furnished with only the most scanty supply of water, most of which is brackish. Formerly, if we may judge by the great number of ruins, the supply was greater. The natives, as Doughty, among others, records, believe that there are great numbers of lost springs which the European by his strange arts can cause to flow again. It is these which the Sultan probably hopes to reopen.

The difficulties attendant upon the construction of the pilgrim railroad from Damascus to Mecca are much greater than is usually realized. They spring not only from the physical obstacles to be overcome, but from the well-known tendency of the Turkish officials to "eat" the money committed to their charge, and from the warlike tendencies of the Arabs. For years the ill-fed, poverty-stricken nomads of northern Arabia—the part known as the Syrian Desert—have been intermittently at war with the Turks, their nominal masters. The same is true of the people of Yemen, the part of "Fortunate Arabia" south of Mecca. At present a Turkish army is trying, as it has tried for a decade, to hold them in check and reduce them definitely to submission to the Porte. Finally the Wahabis, a reformed sect of Mohammedans in central Arabia, are on the war-path. In June one of their leaders from Nejd, or Upland Arabia, was reported by the Egyptian Gazette to be threatening Medina, the present centre of railway construction. The Turks appear to be unable to cope with both the Arabs

and the desert. In the winter of 1904-5, Achmet Faizi Pasha, with ten battalions of Turkish troops, made a remarkable journey from Meshed Ali, near Bagdad, to the Wahabi capital of Hayil, in the centre of northern Arabia. Thence, undaunted by heat and fatigue, he marched across the desert to Medina and Mecca, which he reached in May. In the fall of 1905 he marched upon Sana, farther south in Yemen. Heat, thirst, poor food, and lack of proper clothing caused terrible distress and sickness among the troops. Those who returned home brought such fearful accounts of their hardships that to-day the Turkish Government finds it almost impossible to procure recruits for Arabia. Men flee to the mountains or suffer fines and imprisonment rather than go to a land where they expect to perish. All undertakings in Arabia, whether railroads or military movements, meet almost unparalleled obstacles in the adverse geographic conditions. E. H.

PHILIPPINE ETHNOLOGICAL PAPERS.—The Philippine *Journal of Science* is printing a series of articles on Philippine ethnological and ethnographical subjects which will be of fundamental importance to all who are interested in the peoples of the Philippine Islands. The first article, "The non-Christian Tribes of Northern Luzon," by Dean C. Worcester, appeared in the number for October, 1906 (Vol. 1, No. 8).

The author refers to the confusion as to the classification and geographical distribution of the non-Christian tribes in this area, discusses three of the latest and most authoritative classifications—by Prof. Blumentritt in 1882, who recognized 24 tribes; by the priests of the Jesuit mission of Manila, who in 1899 enumerated 36 tribes; and by Dr. David P. Barrows, who showed that in earlier classifications a superlative number of designations had been given to what are practically identical people, many groups being designated as tribes simply because they had dialects more or less peculiar to themselves. Barrows divides the non-Christian tribes into the Negrito and Malay races, the Negrito forming only one tribe and the Malay three tribes—the Igorot (divided into twelve dialect groups), the Ilongot, and the Bukidnon.

Worcester recognizes the following tribes in northern Luzon:

I—the Negritos; II—the Ilongots (Ibilaos); III—the Kalingas; IV—the Ifugaos; V—the Bontoc Igorots; VI—the Lepanto-Benguet Igorots; VII—the Tingians.

He describes each of these tribes, giving its habitat and a brief account of the physical characteristics of its members, their dress, ornamentation, settlements, hunting, fishing, agriculture, manufactures, methods of warfare and head hunting, weapons, music and dancing, marriage customs and customs relating to the burial of the dead. He does not discuss folklore or religious beliefs. A large number of photographs of individuals, groups, huts, settlements, fields, industries, handiwork, dances, etc., illustrate the paper.

SAKHALIN ISLAND.—Mr. Max Funke has put into pamphlet form the results of his studies of Sakhalin, and it has been issued in the series of studies in applied geography by the Gebauer-Schwetschke publishing house at Halle on Saale under the title "Die Insel Sachalin." It is a concise, clearly-written and well-arranged treatment of the geography, geology, ethnography, industries, and inhabitants of the island, giving, in 33 pages, a comprehensive, if not detailed, account of the subject. A list of works on Sakhalin, many of them in Russian, is appended.

EXPLORATION IN THE HIMALAYAS.—It will be remembered that the British Government recently denied the request, preferred in behalf of an expedition to

be led by Dr. T. Longstaff, for permission to travel through the southern edge of Tibet in order to reach a favourable place for a proposed attempt to ascend Mount Everest. Thus defeated in his plan, Dr. Longstaff, Col. Bruce, and Mr. Mumm, with the Brocherel brothers, Alpine guides, went to the Garhwal Himalayas to climb a number of the summits. On June 12, the party ascended Trisul, which has a height, according to the Indian Trigonometrical Survey, of 23,406 feet. This is believed to be the highest elevation yet attained by man. At 8.30 A.M. the party left the camp, elevation 16,750 feet, reached the summit at 4 P. M., and were back in camp 3 hours later. The going was steep but easy, on about six inches of snow. It was very cold, and the wind whipped up the snow and drove it through the clothing of the men.

PROGRESS IN TIBET.—The "Returns of Trade" of the Chinese Maritime Customs for 1906 contain some general remarks on conditions in Tibet (pp. 557-8). A British trade representative has for two years been stationed at Gyangtse in Central Tibet. The roads in the interior have been so far improved that the British trade agent in January last was able to drive two motor cars between Phari on the frontier and Gyangtse. Chinese trade representatives have been appointed to the three marts open in Tibet to foreign trade. The imports and exports, however, only amounted to about $750,000. It cannot be expected that the resources of such a country will largely increase unless the mineral wealth of the land, which is reputed to be considerable, is exploited. There are large tracts of placer and quartz gold fields and turquoise mines as yet undeveloped.

RUSSIAN EXPLORATIONS IN ASIA.—Russian explorers are about to engage in a number of scientific expeditions for the exploration of the Russian possessions in Asia and the neighbouring territories. Particular attention is to be given (*Pet. Mitt.* No. 9, 1907, p. 215) to the study of the minerals of Siberia.

Captain Belinski, with six companions, began a journey at the end of May, which, it is expected, will keep the party in the field for six years. The route lies through Semiryetchensk and Mongolia to the region of the Altai Mountains, thence through the Minusinsk district to Lake Baikal, from Nerchinsk along the Amur in the Trans-Amur region, and finally through the land of the Yakuts to Bering Strait, and across Kamtchatka to Vladivostok. The chief purpose of the expedition is to make an investigation of mineral resources, with a view to further development of mining.

Mining engineer K. N. Tultshinski, late last year, began a preliminary geological reconnaissance in the northern part of Sakhalin. His results will be the basis of a systematic geological investigation of the Russian part of the island. A topographical survey of this region will also be carried out.

The well-known explorer of the Caucasus and the Tian Shan Mountains, Prof. Dr. G. Merzbacher, started on April 17 on a new journey to Central Asia accompanied by Prince Arnulf of Bavaria, who expects to have rare opportunities for hunting, and the geologist Dr. Leuchs. Dr. Merzbacher plans to make further explorations in the Tian Shan, where he has already spent about two years. He expects to return home early next year.

According to the *Athenaeum*, a scientific expedition for the exploration of Central Asia has been organized by the Imperial Russian Geographical Society. It will be under the leadership of Mr. Kozlof, the old comrade of Przevalski. Kozlof is well known for his own explorations in Mongolia and eastern Tibet.

The expedition will leave this autumn, and proposes to spend two years in the close examination of southern Mongolia and the western parts of the Chinese provinces of Kansu and Szechuen. It is said that the entire cost of the expedition will be borne by the Emperor.

AUSTRALIA.

NORTHERN TERRITORY OF SOUTH AUSTRALIA.—The Society is indebted to the Government of South Australia for ten publications relating to the Northern Territory, the vast region, chiefly tropical, which has large possibilities in its agricultural, grazing, and mineral resources, though as yet its population and development are small. The report of the Government Resident for 1905 deprecates the heavy burden settled upon the inhabitants (about 6,000) of the cost of the railroad between Palmerston and Pine Creek, which was started as a transcontinental line from Port Darwin (Palmerston) to Adelaide, and was never meant to be a burden to the inhabitants of the extreme north, who were saddled with the cost of the construction of this part of the road. The line is conspicuous on our maps as extending from the northern coast to the Pine Creek mining district, a distance of 146 miles.

The report of the Government Geologist in 1905 says that along this railroad from Port Darwin to near the Adelaide River, 74 miles, the country is undulating, open forest, with large kangaroo and other coarse varieties of grass. From the Adelaide River the road passes into the mining region (alluvial gold), and the country is more hilly, with extensive plains and many creeks, some of which are lined with bamboo, giving a picturesque and tropical effect to the landscape. The traveller is impressed with the idea that the country is valuable, and the flat portions seem to consist of good, cultivable soil. Pine Creek consists of a few railroad and business buildings, a good hotel, and post office and telegraph and police stations. All buildings are of galvanized iron, with a few tin and bark shanties. The escarpment forming the edge of the tableland is seen to the south.

There are about 7,400 square miles of metalliferous country in the northwestern portion of the Northern Territory, gold, tin, and copper being the principal metals. Some of the gold finds in the past were very rich; but although much work has been done in surface prospecting, there are still considerable areas which have not been carefully studied.

In 1905, the Government sent a prospecting party to the southwestern and western portions of the Northern Territory in charge of Mr. F. R. George, who, unfortunately, contracted a fatal illness before the trip was completed, and the work was then directed by Mr. W. R. Murray. The journal of this expedition, printed this year, shows that the party encountered excessive summer heat in a waterless area and underwent great hardships. The experiences of the party make it clear that attempts to explore the country along the western Australian boundary line in the heat of summer must result in failure. Away from the ranges, useful waters are rare and feed for camels scarce.

The only locality in the Petermann Ranges where gold was discovered was the Foster Cliff, but it was not in paying quantity. Most of that region is alluvial flats and sandhills, eruptive rocks comprising but a small area.

The publications include reports on cotton-growing, by Messrs. J. G. Jenkins and John Bottomley, both of whom speak most favourably of the suitability of the soil and climate of the Northern Territory for the production of cotton. The

frequent reports on this territory which the Government is issuing are establishing the fact that it promises in time to be a valuable tropical colony.

EUROPE.

GEOGRAPHY AT THE BRITISH ASSOCIATION.—The annual meeting of the British Association for the Advancement of Science was held at Leicester, England, during the week beginning July 31. In his presidential address Sir David Gill of Cape Town said that at the cost of The British South African Company the survey of an arc of the meridian has been carried northward to 9° 42′ S. lat., so that there is now continuous triangulation from Cape Agulhas to within 50 miles of the southern end of Lake Tanganyika—that is to say, a continuous geodetic survey has been completed over 25 degrees of latitude.

The papers read in the Geography section were fully up to the standard in number and interest. The address of the President, Mr. G. G. Chisholm, dealt with the relations of geography from an historical, and especially from an economic, point of view. He regards as the greatest feature of modern commerce its promotion of the increase of population nearly all the world over. It has rendered it possible for manufacturing and commercial peoples to depend in very large measure for their means of subsistence on supplies brought from the ends of the earth. It has rapidly pushed the settlement of vacant land to the base of the mountains and the edge of the desert. We are nearing the time when "new lands" in the temperate zone will all have been allotted. The results of such a check to expansion will be momentous, but the nature of these results we are as yet unable to foresee. He was convinced, however, that if we shall become able to make any probable forecast as to the course of future development one of the most important aids must consist in the study of the relations of geography and history from the commercial point of view.

Major C. F. Close, discussing the survey of British Africa, said that there are now properly-organized survey departments in the Anglo-Egyptian Sudan, Uganda, East Africa, Southern Nigeria, and the Gold Coast. In addition, an exact topographical survey is in progress in the Orange River Colony; and in Cape Colony a military reconnaissance survey has been in progress for two and a half years. The annual cost of these surveys is about $400,000. British Africa has an area of about 2,690,000 square miles, and during the current year about 45,000 square miles will have been topographically surveyed; and to this must be added many compilations, the surveys of boundary commissions and cadastral surveys, such as those in Uganda, where the land holdings of native chiefs are being surveyed on a small scale.

Captain T. T. Behrens read a paper on "The Modern Explorer; his maps and methods," in which he dealt with temperate and tropical conditions of surveying and illustrated the methods of African field work by lantern-slides showing survey operations.

Prof. J. W. Spencer, of the United States, spoke on the recession of Niagara Falls, summarizing the conclusions in his recent monograph and illustrating his remarks by lantern-slides and maps.

Mr. J. D. Rogers read a paper on explorers and colonists, in which he showed that most early explorers were really colonial enthusiasts, whose colonial aims were failures or were carried out long afterwards by persons of a different stamp. Columbus and Cabot were crusaders; Frobisher would have planted a

colony in Baffin Land but for an accident to his store-ship; in the Pacific, Magellan waged holy wars, and Mendaña, Quiros, and Torres founded colonies whose members refused to remain. A second group of explorers in the Pacific consisted of privateers or commercial pioneers who tried to advance war or trade respectively, Roggeween being typical of the first class, Tasman of the second, and Dampier of both. A third class of Pacific explorers included De Bougainville, who took home a Tahitian in order to pave the way for a French-Tahitian Dominion. Cook in his third voyage had two sets of instructions, the secret instructions urging him to annex, with a view to settlement. The foundation of New South Wales was exclusively due to the advice of Cook's travelling companion, Sir Joseph Banks. Probably if these men could have known that posterity would revere them as explorers they would have felt that history was to throw away the kernel and keep only the husk of what they did. He appealed to writers and students to look more at the ideas behind facts and less at the mere external, accidental results, and to use their imagination as well as their intellect and industry in interpreting history.

THE STUDY OF FRENCH GLACIERS.—The "Service d'études des grandes forces hydrauliques dans la région des Alpes" has as its field of work the region between Switzerland, Italy, the Mediterranean, and the Rhône. It is studying available water-power by means of many gauging stations; also the relation between precipitation and flow-off, the variation of precipitation and, in the more elevated parts of the Alps, the glacial contributions to the rivers. According to Mr. Imbeaux, glaciers between April and August supply about half of the water in the Durance River. To a certain extent the economic value of the lower valley of the Durance River depends in summer upon the glaciers on the Pelvoux *massif*. It is from this river that Marseilles derives its supply of potable water. The Italian engineer Fantoli has demonstrated that in the basins of lakes Como and Maggiore each square kilometer of glaciers produces in summer 650 liters of water a second, while a square kilometer of ordinary land gives only ten to twelve liters a second. It is important, therefore, to have accurate information concerning the extent of glaciers and to study the variations to which they are subject. A number of observers have been detailed to study the glaciers in the French Alps and the Pyrenees.—(*La Géog.*, No. 6, 1907.)

POLAR.

THE ARCTIC CONTINENTAL SHELF.—In the course of the paper which Dr. Nansen read on "North Polar Problems" before the Royal Geographical Society, in April last, he discussed at some length the problem of the Arctic continental shelf. He said in effect that the deep North Polar basin forms the northern termination of a series of depressions of the earth's crust which extend north through the Norwegian sea from the eastern Atlantic and form a dividing line between the continental masses of the Old and New Worlds. The eruption of the Jurassic basalts of Franz Josef Land and Spitzbergen may have had some connection with the sinking of the bottom of the North Polar Sea, but the basin was probably, to a great extent, formed before the outpouring of these basalts. As yet, newer volcanic rocks are not known from the edges of the North Polar basin. De Long reported basalt on Bennett Island, but we do not know its age.

It is most improbable that any block of land (horst) could have remained isolated in the middle of such a basin surrounded by deep water on all sides and

without having any connection with the surrounding lands or continental shelves. It is therefore of great importance to determine where the continental shelf ends, off the known coasts. But the edge of the continental shelf in the North Polar region is only known exactly in two places—to the north-west of the New Siberia Islands and to the north of Spitzbergen, while in the region between these two places we know only the deep sea to the north.

Except in these two places we have little direct knowledge of the limits of the continental shelf. The rule that such shelves are narrower outside high and mountainous coasts than off low, flat lands only holds good where the mountainous formation of the coast is in near relation to its trend, and to the continental slope outside, and also where the coast-line is built of primary rocks. This seems hardly to be the case on the northern coast of the American Archipelago and Greenland, though there are many high promontories in places.

It is possible that along the northern coast of Alaska the necessary conditions are fulfilled, and therefore the shelf may be narrower there; but even this is uncertain. It is possible that the deeper soundings which have been made there may merely indicate the presence of numerous submarine valleys, so that further observations are necessary to delimit the continental shelf in that region. But it cannot be said that the geomorphologic features of the known part of the Arctic regions exclude the possibility of a wide continental shelf, possibly with lands on it, which may extend into some parts of the unknown north.

The marine currents and the ice-drift seem to indicate that there is an extensive tract of sea to the north of the *Fram's* track. Peary's experiences also indicate that there is much sea to the north of Greenland. The ice-drift converges towards the opening between Spitzbergen and Greenland, and Peary's observation of a rapid eastward drift also indicates that there may be much land to the east of his northward track. But as we do not know the depths over which Peary travelled, we cannot say much with regard to the possibility of land or continental shelf farther north and east. The drift of the *Jeannette,* also, did not indicate land to the north.

As sledge journeys do not give sufficient opportunity for soundings and oceanographical work, Dr. Nansen is of the opinion that the best results will be obtained by allowing a ship to drift from the sea north of Bering Strait or western Alaska across the unknown north and towards Greenland. The drift could probably be accomplished in five years.

The British South Polar Expedition.—Mr. E. H. Shackelton's expedition left England for the Antarctic regions on July 30, sailing in the *Nimrod,* a Newfoundland vessel of 227 tons, adapted to withstand great ice pressure. Mr. Shackelton will join the vessel at Lyttelton, New Zealand, and until then the *Nimrod* is under the command of Lieut. Rupert England, who was second in command of the *Morning* on both her voyages to Antarctic seas in relief of the *Discovery* expedition.

The members of the party on board the *Nimrod* are Mr. James Murray, the biologist; Mr. W. A. Michell, surgeon and zoologist; and Mr. A. F. Mackay, the junior surgeon of the landing party, who will also engage in zoological work. The remaining members of the expedition besides Mr. Shackelton, who are to join the ship at Lyttelton, are Mr. E. Marshall, senior surgeon of the shore party and cartographer; Lieut. Adams, who will be in charge of the meteorological work; and Sir Philip Brocklehurst for survey work and field geology. Dr.

David, professor of geology in Sydney University, has arranged to accompany the expedition south to King Edward VII Land.

VARIOUS.

ECONOMIC GEOLOGY says that the Maryland Geological Survey is preparing, in co-operation with the U. S. Geological Survey, a series of folios which will be published by the latter organization on the scale of one mile to the inch, extending from the Alleghany Plateau to Chesapeake Bay. The object of these folios is largely educational, since they present the sequence of geological formations of the middle Atlantic border from the Archæan to the Pleistocene, and will offer to students the most recent interpretation of the geology of this belt.

DR. ALEXANDER N. WINCHELL, of the Montana State School of Mines, has been elected to fill the Chair of Petrography and Mineralogy formerly held by Prof. William H. Hobbs in the University of Wisconsin.

A MONUMENT is to be erected at Gotha to the memory of August Petermann, the great geographer and cartographer. His name is especially connected with the founding of *Petermanns Mitteilungen*, the promotion of polar research, and the encouragement of German participation in the exploration of Africa.

THE COMMITTEE ON SEISMOLOGY.—The first meeting of the Committee on Seismology of the American Association for the Advancement of Science convened in Washington on April 19. The Committee adopted resolutions to the effect that its functions should be regarded as initiatory and advisory; that the support of the Federal Government in seismological work should be asked; that this work requires the co-operation of the various scientific bureaux of the Government; that the appropriations for seismological stations should be made through the U. S. Weather Bureau, and that the results of the observations should appear in its publications. The Committee was permanently organized by the election of H. F. Reid as chairman and William H. Hobbs secretary. The next meeting is to be held in Chicago in December, during the meeting of the American Association. The members of the Committee are L. A. Bauer, W. W. Campbell, C. E. Dutton, G. K. Gilbert, J. F. Hayford, W. H. Hobbs, L. M. Hoskins, T. A. Jaggar, Otto Klotz, A. C. Lawson, C. F. Marvin, W. J. McGee, H. F. Reid, C. J. Rockwood, Jr., and R. S. Tarr.

CAMBRIDGE UNIVERSITY has conferred the degree of Doctor of Science on Sir Clements R. Markham, formerly President of the Royal Geographical Society; and also on Sir Thomas H. Holdich, known for his geodetic work in India and his writings on India, Abyssinia, South America, etc.

INTERNATIONAL MARINE INVESTIGATIONS.—The Executive Committee of the Swedish Hydrographic-Biological Commission has drawn up a summary of the results so far obtained by the international investigations of the North and adjacent seas. In the course of the report, numerous biological researches are described, but by far the greatest detail is accorded to hydrography. The main result has been the discovery that European seas are flooded every autumn by Atlantic water (of 35 *per mille* salinity or more), which withdraws in spring, and that many fisheries depend on these movements. Such a fishery is that of the Swedish winter herring; the fish is abundant and the fishery prosperous when

southern bank-water, of characteristic salinity, temperature and plankton, forms a thick layer in the Baltic entrances, while in years of exceptional abundance of Atlantic water this displaces the overlying bank-water and a "bad herring year" results. These years occasion considerable distress.

THE NORWEGIAN STORTING has voted 40,000 Kroner to Roald Amundsen in recognition of his services to science in traversing the northwest passage and relocating the magnetic North Pole.

DR. CHARLES DUCHESNE has published a monograph of thirty-four pages with the title "L'Enseignement des Projections cartographiques" which may well be added to "Helps to Teachers." He first treats of the theory of projections as he believes it should be presented to the pupil. He then discusses the eleven projections that are most commonly used, showing to what cartographic purposes each is best adapted, developing their mathematical bases, and explaining the advantages and disadvantages of each of these cartographic methods. The last eleven pages are given to an exposition of what the author regards as the best pedagogic method of presenting these projections to geography classes. He gives lists of maps that may be used for illustrative purposes, and quotes the views of a number of writers on map projections for the criticism of the reader.

The subject is simply, clearly, and concisely presented. The author has endeavoured to adapt his system of instruction to the needs of pupils in the higher grammar or high-school grades. It is certain, at least, that the ideas which he presents are among those which should be taught to students of mathematical geography. The paper has been published in the *Bulletin* of the Royal Geographical Society of Antwerp, and is also issued separately by D. Cormaux, Liége, at 1.50 fr.

ACCLIMATIZATION OF THE WHITE RACE IN THE TROPICS.—Colonel Wm. C. Gorgas, of the United States Army, well known for his splendid work in Havana and in the Panama Canal zone, has recently expressed himself very forcibly regarding the future of the white race in the tropics. His view is extremely optimistic, and is therefore at variance with the generally accepted opinion on this subject. Colonel Gorgas says (address at Cornell University, June, 1907).—"I think that sanitation can now show that any population coming into the tropics can protect itself against disease by measures that are both simple and inexpensive; that life in the tropics for the Anglo-Saxon will be more healthful than in the temperate zones; and that gradually within the next two or three centuries tropical countries, which offer a much greater return for man's labour than the temperate zones, will be settled by the white races, and that again the centres of wealth, civilization and population will be in the tropics, as they were in the dawn of man's history, rather than in the temperate zones, as at present."

In spite of the decreasing danger of contracting the specific so-called "tropical diseases," Anglo-Saxons will continue to find hard outdoor labour under a tropical sun impossible; they will still suffer from the enervating effects of the "hot-house air" of the moist portions of the tropics; they will still be forced to *tolerate* the climate, and not be independent of it. As Benjamin Kidd well said, albeit perhaps in a somewhat too exaggerated way: "In the tropics the white man lives and works only as a diver lives and works under water."

R. DEC. W.

TREES AND LIGHTNING.—In a recent book on *Forest Protection*, by W. R. Fisher, there is a review of the investigations which have been made in Ger-

many and elsewhere, of the liability of trees to be struck by lightning. In the forests of Lippe-Detmold Hess finds (1874-1890) that among broad-leaved trees the oak suffers most, and among conifers the Scots pine. Spruce and beech come next. Birches, poplars, ashes, alders, willows, and other trees suffer only exceptionally. Considering the beech as 1, the danger is 6 for spruce, 37 for Scots pine, and 60 for oak. Hellmann, taking the beech as 1, finds 15 for conifers, 54 for oaks and 40 for other broad-leaved trees. Hess (1896) found that pyramidal poplar is often struck, and in eight out of ten cases he observed lightning passing from the tree to a neighbouring building. According to Collodon, near the lake of Geneva poplars rarely suffer from lightning. Fischer distinguishes between oily trees and starchy trees. The green wood of the oily trees is a bad conductor, while the starchy trees are good conductors. Conifers are intermediate. Starchy trees are more in danger from lightning than oily trees. When sound, well-conducting trees are struck, growing on damp soil, the lightning probably passes rapidly to the earth, without causing much breakage. When rotten wood is encountered, the crown or branches may be broken or the tree may even be set on fire. Observations in the Saxon State forests make it appear that local conditions, such as proximity of lakes, dampness of soil, density of growth, healthy or unhealthy condition of trees, affect the question whether one species or another is more liable to be struck in any particular locality.—(*Quart. Journ., Roy. Met. Soc., July, 1907.*)

R. DEC. W.

IN HIS MESSAGE to the Brazilian Congress on May 3, 1907, President Affonso Penna reported that a geological and mineralogical service had been organized to study the geological structure and mineral resources of Brazil. It will collect and disseminate information in regard to the mineral wealth of the country.

DR. JOHN M. CLARKE, Director of the New York Geological Survey, has gone to Europe to attend the centenary of the Geological Society of London as delegate from the State Survey and from Section E of the American Association for the Advancement of Science. He will also attend the meeting of the Geological Society of Germany in Basel, whence a two-weeks' trip across the Alps will be made under the guidance of the German and Swiss geologists.

THE REDUCTION of the magnetic observations made by Amundsen in the neighbourhood of the North Magnetic Pole is now in progress under the direction of Prof. Mohn and Aksel S. Steen. Amundsen's continuous registrations of the three magnetic elements were made at Gjöa harbour (Nov., 1903, to May, 1905, inclusive) and at King's Point (October, 1905, to March, 1906, inclusive).

THE GEOLOGICAL SURVEY OF ALABAMA, in co-operation with the U. S. Geological Survey, has been engaged since 1898 in the systematic investigation of the water resources of the State. Dr. Eugene A. Smith, State Geologist, has prepared a volume of 388 pages on the results of these investigations, which has been printed by the State Survey. Many well records are given, together with a discussion of the geology of the State, the amount of water available for artesian wells, the movements of underground waters, and a detailed description of underground waters classified by geological horizons. The volume, which is well illustrated by photographs, concludes with a chapter on the chemistry and classification of Alabama waters.

PROFESSOR A. E. VERRILL has just supplemented his preliminary paper on the

geology of the Bermuda Islands, which was published in the *American Journal of Science* (Vol. 9), with the results of his later studies, which fill 278 pp. of the *Transactions* of the Connecticut Academy of Arts and Sciences (Vol. XII). This report gives a more detailed account of the geology and palæontology of the islands and of the Bermuda coral reefs and their characteristic forms of life. The monograph is illustrated by 181 photographs and figures.

NEW MAPS.

AMERICA.

U. S. Geological Survey Maps.

United States.—Map of Yosemite Valley. Scale, 1:24,000, or 2,000 feet to an inch. Contour interval, 50 feet. Topography by F. E. Matthes. U. S. Geological Survey, Washington, 1907.

The survey for this map was made by the U. S. Geological Survey in co-operation with the State of California. It affords a particularly instructive example of modern detail mapping. Comparison with the standard Yosemite quadrangle, published several years ago, is suggestive. That sheet, on a scale of 1:125,000, or 1.9 statute mile to an inch, well expresses the general character of the sculpturing of the Sierra Nevada. It shows distinctly the glacial sculpture, on the one hand, and the non-glacial on the other. The new detailed map, however, is on a scale so large that it represents a glaciated cañon of exceptional form, with enough detail to shed light on the cause of its aberrant characteristics, which are due to local influences. In other words, the topographer has depicted the Yosemite Valley not merely as a glaciated cañon, but as a glaciated cañon in a region of unusual rock structure. As Mr. Matthes defines the work, "It is a map giving index forms of differential erosion and cliff recession, and it brings out the fact that the aberrant character of the Yosemite topography is intimately linked with the structural vagaries peculiar to the rocks of the Yosemite region."

The area covered is about 70 square miles. It not only shows every waggon road, trail, and house, as on the regular sheet, but the larger scale permits every bend in the roads and every turn in the tourist trails to be indicated.

A part of the survey was made during the fall of 1905, when the Yosemite Falls were entirely dry for two months. The surveying party were therefore able to run a line to the very foot of the Upper Yosemite Fall, where mapping operations are usually precluded by clouds of spray. It was found that the height of the Upper Fall is 1,430 feet; considerably less than the popular estimates.

U. S. Hydrographic Office Charts.

Pilot Chart of the North Atlantic Ocean, August and September, 1907.
Pilot Chart of the North Pacific Ocean, September and October, 1907.

Alaska.—Sketch Map of the Glaciers of the Yakutat Bay Region. Scale, 8 statute miles to an inch. By Ralph S. Tarr. *Bull.* 9 of the Geological Society of America, New York, 1907.

The map is based on the Alaska Boundary Tribunal Map. The studies of Tarr

and Martin in 1905 proved that the recession of the glaciers in Yakutat Bay had continued up to that time; but in 1906 Tarr found that the part of Malaspina Glacier which borders Yakutat Bay was advancing, and three of the smaller glaciers were also pushing forward.

CANADA.—Commercial and School Wall Map of the Dominion of Canada. Scale, 1:2,770,000, or 43.7 statute miles to an inch. W. and A. K. Johnston, Ltd., Edinburgh. The George M. Henry Company, Toronto, 1907. (Price, £1 7s. 6d.)

A new edition recording the latest facts and showing marked improvements in mechanical production. The hill features have been entirely redrawn, and the map gives a good idea of the topography, which is all the more desirable because some of the leading Government maps do not show the Canadian mountains. Its size is 84 by 50 inches. Details can be clearly seen at some distance. One of the new features is the red type showing the distribution of the various natural products. The location and nature of the fisheries and the routes and distances between Canadian ports and foreign countries are given.

MEXICO.—Carta General de Vias y Comunicaciones de los Estados Unidos Mexicanos. Scale, 42 miles to an inch. Edited by Alfredo A. Jiminez. Rand, McNally & Co., no date. (Price, $8.)

Gives the state and national boundaries, uses different symbols for the several railroad systems and steamship lines, and indicates all the sea routes followed by the merchant marine and the position of lighthouses. The nomenclature is large.

PERU.—PROVINCIA DE HUAMACHUCO. Scale, 1:500,000, or 7.8 statute miles to an inch. Cuerpo de Ingenieros de Minas del Perú. Lima, 1907.

Illustrates Boletin No. 51 on the mineral resources and mining of the three rich and important districts of Cajabamba, Otuzco, and Santiago de Chuco. All the mines are indicated.

ASIA.

ASIA.—The Library Map of Asia. Scale, 1:9,218,880, or 145.5 statute miles to an inch. Size, 52 by 43 inches. W. and A. K. Johnston, Ltd., Edinburgh, 1907. (Price, 15s.)

The latest revision of the well-known wall map of Asia by this firm. It is thoroughly up to date, showing, for example, the railroad system of Korea as far as developed, and the completed and projected parts of the Pilgrim Railroad from Damascus to Mecca. The steamship routes from all ports, with distances in days of sailing, and the submarine cables, including the new Celebes-Guam-Shanghai cable, are given. This is one of the most useful wall maps of Asia.

PERSIA.—Geologische Routenkarte von (Blatt I) Zentral-Persien und (Blatt II) des Nordwestlichen-Persien nach eigenen Aufnahmen von A. F. Stahl. Scale, 1:840,000, or 13.2 statute miles to an inch. *Pet. Mitt.*, Vol. 53, No. 8, Justus Perthes, Gotha, 1907.

This fine geological map illustrates a paper by Mr. Stahl on his geological observations in central and northwestern Persia, the first part of which appears in the No. 8. The route extended from Resht to Teheran, Kum, Isfahan, and Hamadan. Twelve tints are used to show the geological formations, heights are given in meters, and observations embrace a considerable area on both sides of the route. The topographical features of the route were described and mapped in No. 6 of the same volume.

CHINA.—Canton Harbour. Scale, one-fourth mile to an inch. *Returns of Trade* of the Imperial Chinese Maritime Customs for 1906, Part 2, Vol. 4, Shanghai, 1907.

Shows the river front, anchorages, harbour limits, railroad station, export and import sheds, etc.

CHINA.—Map of the Swatow Customs District. Scale, 15 statute miles to an inch. Returns of Trade (as above), Shanghai, 1907.

Shows the boundaries of prefectures and districts in the customs district, the customs offices, and the distribution of the principal products tributary to Swatow, the head customs office.

MALAY PENINSULA.—Malay Peninsula. Scale, 55 statute miles to an inch. London, 1907.

Illustrates the third edition of the "Handbook of the Federated Malay States," published by Stanford, London. The British possessions are distinguished from the Federated Malay States, and the routes of constructed and proposed railroads are shown. The same volume contains large-scale sketch maps of the Federated Malay States—*viz*, Perak, Selangor, the Nigri Sembilan, and Pahang.

AUSTRALIA.

NORTHERN TERRITORY OF SOUTH AUSTRALIA.—Petermann and Blood's Ranges. Scale, 8 statute miles to an inch. Compiled from data in Mr. F. R. George's note books. Adelaide, 1907.

This map in colours is a geological sketch plan of these ranges, which are in the extreme southwestern part of the Northern Territory. The metamorphic and igneous ranges and hills are distinguished from the recent and Tertiary sandhills and plains and alluvial flats. The map is one of the results of the remarkably difficult expedition made by Mr. George to this region in 1905, during which he succumbed to the hardships of the journey.

NORTHERN TERRITORY OF SOUTH AUSTRALIA.—Geological Map of the Northwestern District, Northern Territory of South Australia. Scale, 12 miles to an inch. Adelaide, 1906.

This map, in colours, accompanies the report on the Government geological explorations made during 1905. Eight tints are used to show the distribution of sedimentary rocks and two tints distinguish between volcanic and plutonic rocks.

EUROPE.

BALTIC SEA.—Die Entwickelung der Ostsee im Anschluss an de Geer. Scale, 1:15,000,000, or 236.7 statute miles to an inch. Three sheets: (1) Yoldiazeit: Eismeer, (2) Ancyluszeit: Süsswasserbinnensee, (3) Litorinazeit: Salzmeer. Geographischer Anzeiger, Vol. 8, No. 6, Justus Perthes, Gotha, 1907.

Shows the changes in the Baltic as revealed by the geological record.

GREAT BRITAIN.—Official Railway Map of England and Wales. Scale, 1:475,200, or 7.5 statute miles to an inch. Prepared and published at the Railway Clearing House, London, 1906.

This is the best railway map of Great Britain. It shows every railroad and station, each railroad system having its own colour. Little topography is indicated, excepting the drainage system, some of the greater elevations, and the shoals along the coasts and in the estuaries. The sea routes to Ireland and the European mainland are given.

GREAT BRITAIN AND IRELAND.—(1) Map Showing the Positions of the Climatological and Rainfall Stations in Great Britain and Ireland; (2) Map Showing the Positions of the Stations having Self-recording Instruments; (3) Map Showing the Positions of Meteorological Stations, the observations from which are used in the preparation of the British daily "Weather Report."

These maps appear in the second *Annual Report* of the Meteorological Committee for 1907. Map 3 shows that information used in compiling the daily weather map is obtained from stations as far east as Archangel and Moscow, as far west as the Azores and Iceland, and from Bodö on the Norway coast to Sfax in Tunisia.

PHYSICAL GEOGRAPHY.

ATLANTIC.—Treibeiserscheinungen bei Neufundland. By Von L. Mecking. *Annalen der Hydrographie*, etc., Deutsche Seewarte, No. 9, 1907.

A series of diagrams illustrating Dr. Mecking's paper on the drift ice near Newfoundland, in its relation to weather conditions.

PACIFIC AND ATLANTIC OCEANS.—Reisen der vom 1 bis 9 April, 1907, im Englischen Kanal angekommenen deutschen Segler "Urania," "Pampa," "Pamir," "Carl," "Prompt" und "Petschili." (Mercator Projection.) *Annalen der Hydrographie*, etc., Deutsche Seewarte, No. 9, 1907.

These six sailing vessels arriving in the English Channel within nine days of one another started from the nitrate ports of Chile, rounded Cape Horn, and made their way across the Atlantic. Their observations as to barometer, winds, and currents are plotted on this chart.

POLAR.

ARCTIC.—Map of the North Pole Regions. Scale about 175 statute miles to the inch. By Gilbert H. Grosvenor. *The National Geographic Magazine*, July, 1907.

An excellent chart of the Arctic regions. Coasts are coloured to indicate the nationality of the explorers who traced them. There are insets showing Smith Sound, Franz Josef Land, and Spitzbergen. The map was prepared to accompany the scientific report of the Ziegler Polar Expedition of 1903–1905, and is used in *The National Geographic Magazine* in advance.

ATLASES.

ATLAS UNIVERSEL DE GÉOGRAPHIE.—Ouvrage commencé par M. Vivien de Saint-Martin et continué par Fr. Schrader. No. 51, Asie en 10 Feuilles. Feuilles VI. Perse, Afghanistan et Inde Nord-Ouest. Librairie Hachette & Co., Paris, 1907. (Price, fr. a sheet.)

This fine specimen of map compilation and cartography shows Baluchistan as a part of British India and the new Northwest Frontier Province. The leading sources from which the map is derived are given.

BOOK NOTICES.

Altitude, Azimuth, and Geographical Position. By G. W. Littlehales. (Philadelphia, J. B. Lippincott Company.)

It is the idea of latitude and longitude, by means of which the location of any place with reference to any other place is determined with mathematical exactness, that underlies all geographical science and that provides the only method by which geographical descriptions may be made accurate. This is especially true of navigation. For here it is necessary that the latitude and longitude of the vessel be known in order to determine the course to be steered to reach the port of destination, or in other words it is essential for the navigator to find, by astronomical observations, where his vessel is with reference to base-lines, like the equator and the first meridian, before he can determine how to proceed.

A geographical map or chart is a graphical tabulation of geographical positions, or latitudes and longitudes of places, by means of which the necessity is obviated for having recourse to the application of the principles of spherical trigonometry and to lengthy numerical computation, whenever we wish to find the direction or azimuth of one place from another and the distance from place to place; and as the geographical map is a graphical tabulation of geographical positions, so this magnificent volume, in which Mr. Littlehales has performed a gigantic labour for the advancement of one of the most useful of the exact sciences, is a tabulation of the results which are requisite for a direct and speedy determination of geographical position and azimuth from the simple astronomical observation of measuring the altitude of a celestial body, which mariners have been used to taking for many generations the world over.

And so the navigator finds the indispensable latitude and longitude and the course to be steered to reach his port of destination by a graphical process easy to understand and to follow, not requiring trigonometry or logarithms, time-saving, brief, simple, infallible. "The subject," remarks the author, "of identifying the celestial body that has been observed, and of simultaneously finding the true bearing and the Sumner line of geographical position with as much precision as astronomical observation taken at sea will warrant, is here treated as if the co-ordinates of the celestial sphere had been tabulated from minute to minute of arc throughout the whole circuit of the heavens, in such a manner that the table, being entered with the estimated latitude of the observer and the declination and hour-angle of the observed celestial body, would give the corresponding altitude and azimuth of the observed body."

In place of the multiplicity of rules and formulas which compose the extended array of works on astronomical navigation, Mr. Littlehales has substituted a single, short rule, applicable alike to observations of all celestial bodies and all situations of the observer, and has doubtless become the author of an instrumentality which is destined to exercise a remoulding influence in the practice of the art of navigation, by lessening labour in this respect, by limiting the chances of error, and by enlarging the field out of which comes the demand upon workers in the lower ranks of science and industry to furnish recruits for occupations that require more skill and yield better rewards.

The "Sumner Line" for Position, originated by Captain Sumner, a man who will ever take rank with Bowditch as a master in the Science of Navigation, has now become almost universally adopted by the seaman; but as it takes nearly double the time to calculate the results of an observation of a celestial body as compared with an ordinary "Time Sight," our navigators are inclined to use it sparingly, notwithstanding the greater certainty added to their calculations by its use. The shorter method of projecting the Sumner Line, given by Mr. Littlehales in his "Altitude, Azimuth, and Geographical Position," will save much time, labour, and eyesight at critical periods when moments are golden. But this method must be particularly welcomed by that class of navigators who seek to check every observation they make by securing several lines of bearing from the same celestial body, or who, by beginning in the early twilight of the day, when the sky is clear and the horizon well defined, observe the altitudes of two or more of the "Stellar Light Houses of the Sky" and provide themselves for the "Day's Work," not only one or two, but four or five positions for checking their computations, before pushing a vessel through fogs and dangers unseen, at the great rate of speed now common to steamship navigation.

A line run through five points thus computed will establish it with mathematical accuracy, and the scientific navigator, who has the enormous interests now sent to sea in one compact body consigned to his charge, cannot be satisfied with less assurance of perfect results than is given by the best work possible to attain. In such navigation, where the saving of numerical computations is augmented four and five times, possible in the Littlehales method, his work will prove a friend indeed.

In the Navy, particularly, where the navigator not only has the lives of his shipmates at stake but takes upon himself, for the ten and twelve million dollar battleships on which he sails, the care that is represented in the insurance risks that great corporations handle for the merchant ships, perfection in the art of navigation will take no second place to any other factor that enters into the use of one of the most costly structures owned by the Government. By such perfect means only can a ship be safely piloted through intricate channels, such as confronted our Navy during the late Spanish-American war in the West Indies, where the lighthouses were unlighted and other aids to navigation destroyed, while our scouting vessels were rushing at great speed to secure a military advantage of the enemy.

At such times as these Mr. Littlehales' method will be appreciated by the weary and anxious navigator who must work quickly and surely; but it should be remembered that here the maxim "In times of Peace prepare for War" has its strongest bearing, for without constant practice in the quieter moments of a seafaring life, confidence, which is so essential for good navigation, cannot be attained.

CH.

The American Scene. By Henry James. vi+443. Harper & Bros., 1907.

There may be something to be gained by a careful reading of this book, if one has the leisure to unravel its tangled phrases. The ordinary reader, however, is repelled by simply glancing through it. Heaviness and verbosity are written only too clearly upon the long, closely-lined pages. One looks in vain for the clear-cut prose "vignettes" and the beautiful illustrations which adorn the recent edition of "English Hours."

It would almost seem that Mr. James, with grim humour (a quality conspicuously absent in the text), had here tried to make his volume reflect his own distaste of his subject.

It is a thankless task to criticise a writer whose refined literary taste and masterly skill in the subtle use of words have enriched our language and given to the world some beautiful compositions. But there is nothing to be said in praise of the present work, except that, here and there, in the midst of weary wastes of useless words and phrases, a whimsical turn of expression, a discerning insight, and a touch, as of a painter's brush, in a reference to nature, give a faint echo of the Henry James we once knew.

Whether as the ancient contemplative person, the restless analyst, the repatriated traveller, or under whatever other conceit he chooses ineffectually to veil his personality, he is ever the cynical, garrulous old man whose pen has lost the "large lucidity" of earlier days. Here the mannerisms which once gave his touch originality are crystallized into monstrosities, and his acute insight obscured by forced impressions and a too evident disgust of "the crudities and vulgarities of this blatant democracy."

Viewed either as a literary composition or as a trustworthy criticism of American art or manners, this work strikes one as neither sane nor sincere. Sense is hard to find in words and phrases tortured out of all clearness and simplicity by perverse use and eccentric arrangement. Criticism is of little value when seen through the medium of Mr. James's prejudiced and preconceived opinions.

His visits to many of the cities about which he writes were out of season and only for a day or two, but for him they "connote" or "send out a general note" with all the clearness of a long and intimate acquaintance.

New York as the birthplace of the "returned absentee" attracted most of his attention, and consequently suffers most from his criticism—though he does acknowledge a grudging fondness for Washington Square as the scene of youthful exploits and recollections.

Aside from much that is grotesque, much that is vague and incoherent, much that, to the unillumined, is unintelligible in this book, still there is something of insight and artistic appreciation which might have come to us as a helpful message had it been conveyed with simple directness and in a volume condensed to one-third the size. H. P. L.

The Story of Dublin. By D. A. Chart, M. A. xvi+368. Illustrations (47) by Howard. Map of Environs. Plan of City. J. M. Dent & Co., London, 1907.

A perusal of the story of this old Celtic city will well repay an appreciative reader. The simple directness of style and evident accuracy of statement carry with them their own recommendation. As the ancient capital of Ireland, the history of Dublin is an epitome of the history of the Kingdom.

It is ever a temptation to a writer to bring out in strong colours the bizarre and tragic events of Irish history. Our author meets this temptation with restraint, and yet with a sympathy that secures the confidence of the reader at once.

The history of Dublin begins with 150 A. D., when it was but a ford on the Liffey, and continues to the present day. During these years we are taken through many stirring scenes of war and politics.

Against Dublin as a background stand out the warlike figures of Olaf and

Thorkils the Danes warring against Conn of a Hundred Battles and Brian Boru; of the traitorous Dermot MacMurrough and his Anglo-Norman ally, Strongbow, contending with the fierce O'Connors and O'Byrnes; of the rival Desmonds and Ormonds, conniving, now with the English, now with the native chiefs.

And later, when peace settles upon the war-scarred city, Grattan, O'Connell, Fitzgerald, and Robert Emmet play their parts in the old Parliament House, the Mayor's Palace, and old Thomas Street.

The second division of the book treats of Dublin the city. Its plan, historic streets, buildings, and squares are described with an accuracy and interest that show intimate acquaintance and rare appreciation.

This portion of the volume is invaluable as a guide-book for tourists and as a mine of information to the antiquarian. For the ordinary reader, too, it has its interest. Under the author's pen old Dublin is peopled anew by the men and women who made it and loved it. We can see them sitting in the old Parliament House listening to the fiery eloquence of the United Irishmen, or applauding Peg Woffington in Crow Street Theatre.

The volume is full of fine illustrations and contains also an elaborate plan of the city. It will not appeal to a large audience, but, aside from literary merit, it will always be useful in the hands of any visitor to the city. H. P. L.

Deutsche Kulturaufgaben in China. Vortrag von Legationsrat Dr. Knappe. Schriften der Deutsch-Asiatischen Gesellschaft, No. 3, 1906. Berlin, H. Paetel. 28 p.

In this lecture the former well-known German Consul-General of Shanghai, Dr. Knappe, outlines an impartial picture of the cultural missions and tendencies which the foreign nations have hitherto followed in China. The spread of Western science and education is now making fast progress there; but while the French take the lead with over 5,000 schools, the English and Americans follow them with some 2,000, and the Japanese may soon overtake all of them, it strikes him that German activity, with only six missionary societies, twenty-three schools, and four hospitals, makes a very poor showing, and is rather backward in carrying its educational ideals into the hearts of the Chinese. He therefore lays three practical propositions before the German-Asiatic Society—the establishment of a German school of medicine for Chinese in Shanghai; a higher school connected with it, to prepare Chinese for special study in Germany; a stock of elementary teachers, to be kept in Shanghai, and to be sent to reform schools in the country for instruction in German. Part of these plans are now under way, and look toward a speedy realization. The address is written in a warm and very distinguished tone. B. L.

Die Kultur Japans. Von Dr. Daiji Itchikawa. Berlin, Karl Curtius, 1907. 149 p.

This is a refreshing production by an author of good common sense, who is instructor of his mother-tongue at the Oriental Seminary of Berlin. It is light reading, written in a light style, fortunately not in the heavy academic style, with an admirable command of German; and, for which we are still more grateful to the author, he is, unlike others of his countrymen, free from any stilted phrase, and perfectly sincere and equitable in his judgments. It is remarkable, for example, to hear from the lips of a Japanese the verdict pronounced that there is still much to be desired in the industry of his country, and that one of the manifold reasons for

the deplorable conditions of export-trade and industry is to be sought in the little-developed spirit of the Japanese on economical lines. The Japanese, he says (p. 88), in their over-estimation of mental culture, are prone to neglect material and still more economical culture, and therefore display, contrasted with Americans and Europeans, a lack of economic virtues: for instance, as regards the sincerity of the merchants; the thrift of the people; the idea of right, liberty, and independence; perseverance and courage in the industrial field. The cause of this phenomenon, he sees in the exaggeration of military education, but he believes that economic qualities are compatible with military ones, and will doubtless be instilled into the people at some future day. The book is divided into an historical and an analytical section. In the former, the first acquaintanceship of the Japanese with the Portuguese and Dutch, the introduction of Western civilization, and Japan's position as a Power, are described, followed by a discussion on the visionary spectre of the Yellow Peril, on which subject so much needless ink has been wasted. In regard to the industrial danger, the author very aptly remarks that iron, which occurs very little in Japan, is still the most important product to be imported from abroad, the demand for which will steadily increase with the progress of industry and means of traffic; besides, drugs, chemicals, and dyes will continue to remain notable articles of importation, and the amount of the last still considerably exceeds that of the exports. He thinks, however, that the apprehension that Japan and America will have to compete for the rule in the Pacific Ocean is not quite unjustifiable. He considers this not specifically a Japanese danger, but rather the outcome of the eternal law of the struggle for existence, which forces the empire, increasing yearly by half a million, to seek an outlet for its surplus in population. In this sense, he admits the statement regarding a yellow peril; but as much to the point, and even more so, according to him, is the saying in reference to the white peril, for the colonization, culture, and power of the white peoples have proved to be much more perilous than those of the yellow race. This, he continues, will be realized in a still greater degree when the Panama Canal and the two-tracked Trans-Siberian railway shall have been completed. Japan is therefore bound to build more and more ships, as the best and most suitable bulwark of the insular empire. Since England cannot exist without ships, so to Japan a strong navy is indispensable. If there were no water between Germany and England, the distribution of power in Europe would be widely different.

The second portion of the book is devoted to an analysis of present Japanese culture in science, politics, military matters, education, economical problems, religion, and ethics. Though not written from a scientific point of view, but destined for a larger public, these sketches are most creditable and worth while reading, and American students will also peruse them with pleasure and profit. There is no exaggeration, no wearisome enthusiasm about them; they are straight to the point, clear, and sober-minded, written with an open eye and a very pleasing naïve mind. B. L.

The Chinese Empire: A General and Missionary Survey, with Portraits and Illustrations. Edited by Marshall Broomhall. With preface by the Right Hon. Sir Ernest Satow. London: Morgan & Scott, 1907. xxiv and 472 pp. (7s. 6d.)

The year 1907 calls to mind a landmark in the history of Protestant missions in China, for it was in 1807 that the pioneer of Protestant mission-work, Robert

Morrison of the London Missionary Society, landed at Canton. In celebration of this centenary the present publication has been issued in the form of a general comprehensive survey of the Chinese Empire from the missionary standpoint. Aside from the introduction, there are twenty-four chapters, in which the single provinces are treated seriatim, the preparation of each article having been intrusted to a missionary resident in the field, who by his long experience was specially qualified to write as expert upon his own particular province. This procedure is no doubt very laudable, but it ought to have found in some way or other expression on the title-page. The book is on the whole useful, and imparts a fairly correct idea of the history and present state of the missionary movement, of which the general worker in the Chinese field cannot wholly neglect to take notice. Each essay defines the geographical and economical features of the province with an account of its evangelization and statistical figures. The most interesting chapters are those dealing with the provinces of Yünnan and Kueichou, in which the aboriginal tribes are discussed to some extent. The concluding chapter, on the Bible in China, is valuable from an historical and bibliographical view-point. The statement on p. 415—that "the Nestorian missionaries were the first to enter Tibet, and that the Roman Catholics followed in 1824"—deserves correction. The Nestorians have never set foot on the soil of Tibet, and the history of Catholic missions in that country dates from the year 1708, when the Capuchin Friars reached Lhasa and maintained a number of stations along the route from Nepal to Lhasa: they were followed by the Jesuits (Ippolito Desideri) in 1714. That the Jews had settled in China during the Han dynasty, as stated on pp. 430 and 447, is no more than a traditional fable: the Jews reached China from India not earlier than the ninth century A. D. There are five good indices.

As a companion volume to this book, a large atlas of the Chinese Empire is planned. This is to contain twenty-two maps representing all the provinces and the dependencies of Manchuria, Mongolia, Tibet, etc. The scale of the map of China proper will be 1:3,000,000; that for the dependencies, 1:7,500,000. The drawing of the maps, which are based upon the most recent surveys, has been intrusted to Mr. Edward Stanford, geographer to the King. The spelling of names will be that recently adopted by the Chinese Imperial Post-Office; and the editor expects that, thanks to these new features, it will supersede all earlier maps and atlases. B. L.

The Awakening of China. By W. A. P. Martin. Illustrated from Photographs. New York: Doubleday, Page & Company, 1907. xvi and 328 pp.

The title of this book is hardly to the point, for it does not deal, as one is led to infer, exclusively with life problems of the day, which fill only the concluding chapters. There are three parts all together, the first giving a general and geographical survey of the eighteen provinces and the outlying dependencies of the empire, the second imparting an outline of the history down to the eighteenth century. As was to be expected from such a well-informed writer as Dr. Martin, who spent almost an entire lifetime in China in educational work, these chapters convey a great deal of sane and solid information, and treat the subject in a more rational way than we are accustomed to find in the usual popular books on China. His style is bright and lucid, though at times it soars aloft to somewhat too rhetorical heights. The third part of the book, the history of the nineteenth century and later, is entitled "China in Transformation." It starts with "the Opening of China, a Drama in Five Acts," the so-called acts being the Opium War,

the "Arrow" War, the war with France, the war with Japan, the Boxer war—a rather artificial construction which obscures the natural even course of historical development. Finally the Russo-Japanese War and the present hopeful reforms that are to be instituted in China are discussed at length. A very intimate character-study of the famous viceroy Chang Chih-tung is unrolled. There are two very pleasing features that appeal to one in these sketches—the just appreciation of the merits of the Manchu Dynasty, which has given to China a better government than any of her native dynasties, although the detailed comparison of the Manchu with the Normans does not strike us as a very happy one; and the ready acknowledgment of the good traits in the Empress Dowager, of whom he says that the elegance of her culture excites sincere admiration, and that the breadth of her understanding is such as to take in the details of government. The illustrations of the book are well selected and are all interesting, and there is no doubt that it will be appreciated by a large body of readers. B. L.

British Malaya: An Account of the Origin and Progress of British Influence in Malaya. By Sir Frank Swettenham, late Governor of the Straits Colony and High Commissioner for the Federated Malay States. With a specially compiled map, numerous illustrations reproduced from photographs, and a frontispiece in photogravure. New York: John Lane Co., 1907. ($4.50 net.) xii and 345 pp.

This is an admirable book from beginning to end, a permanent contribution towards the fascinating chapter of British colonial history. No one was better qualified for this task than Sir Frank Swettenham, through his thirty-four years of Malayan service an energetic and prominent participator in the development of the great colony described by him. From a study of this exceedingly well-written work, the reader receives only a feeling of highest admiration for the wisdom of colonial policy which crowned British labour in the Malayan peninsula as a lasting success. The primary factor leading to this end must be sought for in the prudent and fair treatment of the natives, Malayans as well as Chinese, from which all colonial powers ought to take an example. The Chinese the author regards as the main supports of the colony: it was largely on the tin-mines that the protected Malay States depended for their revenue, and it was the first endeavour of the Government to foster this industry by every legitimate means. The Chinese began the work, have continued it ever since, and their efforts have succeeded in producing more than half of the world's tin supply. Sir F. Swettenham's judgment on them is worth quoting *in extenso:*

> Their energy and enterprise have made the Malay States what they are to-day, and it would be impossible to overstate the obligation which the Malay Government and people are under to these hard-working, capable, and law-abiding aliens. They were already the miners and the traders, and in some instances the planters and the fishermen, before the white man had found his way to the Peninsula. In all the early days it was Chinese energy and industry which supplied the funds to begin the construction of roads and other public works, and to pay for all the other costs of administration. Then they were, and still they are, the pioneers of mining. They have driven their way into remote jungles, cleared the forest, run all risks, and often made great gains. They have also paid the penalty imposed by an often deadly climate. But the Chinese were not only miners, they were charcoal-burners in the days when they had to do their own smelting; they were woodcutters, carpenters, and brickmakers; as contractors they constructed nearly all the Government buildings, most of the roads and bridges, railways and waterworks. They brought all the capital into the country when Europeans feared to take the risk; they were the traders and shopkeepers, and it was their steamers which first opened regular communication between the ports of the colony and the ports of the Malay States. They introduced tens of thousands of their countrymen when the one great need was labour to develop the hidden riches of an almost unknown and jungle-covered country, and it is their work, the taxation of the luxuries they

consume and of the pleasures they enjoy, which has provided something like nine-tenths of the revenue. When it is possible to look back upon a successful experiment, it is always of interest to ascertain the determining factors, and how far each affected the result. The reader should understand at once what is due to Chinese labour and enterprise in the evolution of the Federated Malay States.

Equally as just and appreciative is the author in his valuation of the Malayans, whose confidence the Government has gained in a marked degree by making the promotion of their welfare the first consideration, and consulting their chiefs on all affairs of importance. Of the administrative capacity of Malayan rulers, he holds a high opinion. Amongst the Têrak chiefs, men with wide influence and of great authority, there are not a few who have proved their ability to hold high office. There are earnest and capable Râjas, loyal and energetic chiefs, in all the States, and it would be wrong to regard the Malay as a negligible quantity in his own country. The three most prominent Râjas were in no sense the product of English education. None of the three ever had any experience in an English school, but all of them learned much by a keen observation, by a desire to serve their country, and by a close association with British officers in all that has been done to bring the Malay States to their present position:

> A Far-Eastern race which can produce men like these,

concludes the author,

> who, under such circumstances, develop principles as high as those which guide the best Europeans and strive to live up to them, is not to be despised or dismissed as useless. "We have learned by long experience, by our own blunders, and by such success as has attended our venture in Malaya, that when you take the Malay—Sultan, Râja, chief, or simple village head-man—into your confidence, when you consult him on all questions affecting his country, you can carry him with you, secure his keen interest and co-operation and he will travel quite as fast as is expedient along the path of progress. If, however, he is neglected and ignored, he will resent treatment to which he is not accustomed, and which he is conscious is undeserved. If such a mistake were ever made (and the Malay is not a person who is always asserting himself, airing grievances, and clamoring for rights) it would be found that the administration had gone too fast, had left the Malay behind; left him discontented, perhaps offended, and that would mean trouble and many years of effort to set matters right again. All is well now, and a reasonable consideration for the people of the country will keep it well. The danger is that the legitimate aspirations of a people who are too reserved to complain aloud may be overlooked. If this record, with its lessons of the past and the experience of a long and close intimacy with Malays, serve to warn others to avoid that danger, the purpose of the book is gained."

If only the administrators in other Asiatic colonies would make a study of this book and take to heart its golden rules! B. L.

La Colonisation hollandaise à Java. Par Pierre Gonnaud. Paris, Augustin Challamal, Editeur, 1905.

The literature on Java is rich in excellent monographs. Junghuhn has described it from the standpoint of the natural scientist, Raffles from that of the historian, Veth from that of the Dutchman. To these standard works Gonnaud has added another, whose main object is to present the colonial features of the island, to investigate the physiographic foundations, the antecedents, and the character of the Dutch colonisation in Java.

Among the physiographic traits, the one that seems to have impressed most deeply the majority of writers on Java is its volcanic character. But it has been over-emphasized, to the neglect of other, no less prominent, features. While the older formations constitute only about 1% of the surface, the Tertiary plays a part just as important as the volcanic deposits: 99% of the soil consist of Tertiary, Quaternary, and volcanic rocks, but only 28% of the ninety-nine belong to the latter.

The principal volcanoes are arranged on two, in Preanger on four, parallel ridges. They form the backbone of the island, but do not divide it symmetrically: the road from Cheribon on the north coast to Bandoeng on the south shore goes uphill from the former during nine miles of its length, but descends to the latter on the southern slope in one. In addition to this, the north shore faces one of the most densely-populated regions of south-eastern Asia, while the south shore looks out upon a lonely sea. For these two reasons, the geographical opportunities of the two parts of the island have always been different. The coastal plain on the north shore received the overflow population from its continental neighbours and offered them all that was necessary for the foundation of new and lasting settlements, and has, therefore, been the stage of almost all the colonial development of the island. In his treatment of the climatological and biogeographical features of his subject, the author succeeds very well in stating the difference of such treatment by a scientific, or a colonial, geographer. His chapter on the climate of the island emphasizes the influences of the same on the colonists, and that on the animals and plants has been written to show the animal and vegetable *resources* of the island, not the animals and plants for their own sakes. In characterizing the climate as a tropical, maritime climate, he says, in concordance with many others, that it would be less fatal for the colonist from temperate zones if he would live more reasonably and live on the healthier uplands rather than on the dangerous coastal plain. The two climatic factors which determine the climate of Java are the excessive insolation and the monsoons. The excess of light, even more than that of temperature, enervates the white man; the atmospheric humidity adds to the depressing effect. Both air and soil are saturated with moisture, the water of the tropical rainstorms cannot be absorbed by either, it runs off over the impermeable volcanic rocks as well as over the alluvial soil whose limit of saturation has been reached. Thus devastating torrents intersect the south slope; while on the northern, where the grade is less, the rivers carry enormous masses of detritus, which form large bars at their mouths. From north to south, therefore, the rivers create lines of traffic; from east to west, they are obstacles to it. Wherever their waste water is collected in reservoirs, they furnish an abundant supply for the irrigation of rice fields. On the flora and fauna little can be said, because the endogenous character of the same is almost entirely a matter of guessing. It will probably never be ascertained how many of the plants and animals have been introduced by the various colonisations that have succeeded each other on the island. Among the existing plants, a division into a lowland, plateau, and mountain flora can be made; it is less pronounced among the animals, on account of their greater freedom of locomotion. Generally speaking, the prominent feature of each is its unparalleled abundance; and this is also the most important one for the colonial geographer, because this very wealth of the island has, from the earliest times, made it the object of the colonial aspirations of its nearer and farther neighbours.

The native Javanese came from the mainland *via* the Malaccan peninsula. They were an agricultural race and founded numerous small feudal states all over the country. They were superseded, after heroic struggles, of which the native legends relate, by the Malays, who, as a people of skippers and traders, occupied the coast and the lines of trade along the large rivers, while the natives retreated to the interior. Having purely mercantile interests, they never established any formal political power, but Javanese and Malays supplemented each other as the geographical developers of the island; the former raised the crops

that constituted its wealth, the latter established its connection with the outside world. To this division of labour the Hindoos, upon their conquest of the country, added an established social order, and they brought along with them their superior civilization, which enriched the language, literature, and general intellectual status of the inhabitants. These three influences; the original Javanese, the Malay, and the Hindoo, have produced together the native character with which modern colonisation has to deal.

Contrary to these, the Mohammedans during the twelfth and thirteenth centuries estblished states of a religious and mercantile character. They parcelled the land out to individual families, the families were united into groups under chiefs, the chiefs formed groups of their own under the Sultan. Their influence on the language did not, however, go beyond expressions relating to Mohammedan worship and law; the Malays alone gave up their alphabet in favour of the Arabian letters, so that the original Malay language became extinct. The Chinese who succeeded the Mohammedans did not come as conquerors; they were, as they now are, forced to emigrate through the over-population of their own country. There, as elsewhere, they remained strangers in the new country; they kept apart from the rest of the population, always looking forward to a return to their native land, where they had left their wives. They came as merchants and, through their skill in financial operations, have become the "Jews of the East," who loan money to the farmers and expropriate them when they can not pay their debts.

Of the Europeans who attempted to subjugate this motley population, the Portuguese came first. At the time of the maritime glory of Portugal, they extended their colonial possessions eastward beyond Goa by the conquest, one after the other, of the Javanese states. The possession of Java would have made them masters of the Indian Ocean; but the union of Portugal with Spain proved fatal to their plans, because the latter had political ambitions of her own, to which Portugal was made serviceable, and thus it was comparatively easy for the Dutch to take Java from them. After the closing of the Lisbon harbour to Dutch vessels, Holland had to look for new trading-places, and the superiority of her navy made her the mistress of those eastern seas. In 1602 the "Algemeene geoctroyerde Oost-Indische Compagnie" was chartered; it was a syndicate of pure exploitation, and monopolized the trade with Java to the exclusion of every other competitor. When it was dissolved, and the island placed under the Dutch Government, Java began to experience a more beneficial influence of European civilization. During five years of English occupation (1811-1816) many political and social reforms were attempted; but the inhabitants were not ripe for the blessings of a civilization which it had taken England centuries to acquire, and the only lasting result of this incident was the establishment in these seas of English colonial and commercial influence, which culminated in the occupation of Singapore. The Dutch, however, continued to build on the foundation laid by the English and, with an eclecticism that betrays a great amount of colonial tact or instinct, they have succeeded in working out a system of government which secures, likewise, the profit of the masters and the welfare of the subjects. The Dutch colonist brings to the island his capital and brains, which develop its resources, and the native furnishes the labour. This compulsion to work, which he would never accomplish if left to himself, benefits the native both materially and morally, while the political wisdom of his masters leaves his manifold political institutions undisturbed, satisfied to control them at a distance by means of offices which bind the native chiefs to the Dutch Government. As long as this order of things prevailed, the Dutch

power was safely established in Java. But philanthropic work which has recently been started among the natives and which tends to "educate" and "enlighten" them has greatly endangered the position of the Dutch; the claim that the servant is the equal of his master is being misunderstood here as on many other occasions, and what was meant for the good of the natives is fast developing into a menace to the safety of the established power. Considering the comparatively small resources of the mother country in case of a rebellion, this appears to be a more imminent danger than the rivalry of the other Powers interested in the Indian seas.

M. K. G.

A History of the American Whale Fishery. By Walter S. Tower. (Publications of the University of Pennsylvania, Series in Political Economy and Public Law, No. 20.) x and 145 pp., Appendices and Index. The John C. Winston Co., Selling Agents, Philadelphia, 1907. (Price, $1.50.)

The book treats very adequately of a former great industry in the United States. Other histories of the American whale fisheries have been written, but none of them is so complete as this work in its statement of essential facts. The book, moreover, does not merely record events, but also shows the great influence of whaling, in its day, as a social and economic factor. It gives a comprehensive view of the origin and growth of the fishery from Colonial days to the present time, introducing the subject with a chapter on the origin of whaling in Europe. In the later chapters Mr. Tower tells of the ups and downs of the American industry and interprets the conditions which promoted prosperity or depression in it. All the available statistics and a bibliography appear in the appendices.

Costa Rica. By José Segarra y Joaquín Juliá. 655 pp. and Illustrations. Avelino Alsina, San José, 1907.

A comprehensive and popular description of Costa Rica, chiefly for the use of tourists. It treats of the geography, the resources, activities, and intellectual position of the country.

Quelques Peuplades du district de l'Uelé. Fascicule I. Introduction. Les Ababua. Par Joseph Halkin. 155 pp. D. Cormaux, Liege, 1907.

Dr. Halkin's book contains the responses from Europeans in the Congo to a list of ethnographical and sociological questions published by the Belgian Sociological Society; also extracts from the writings of explorers and ethnographists. The large amount of information concerning the Ababua is very methodically classified.

The Oxford Geographies. Vol. III. The Senior Geography. By A. J. and F. D. Herbertson. viii and 363 pp., 117 Maps and Diagrams and Index. Clarendon Press, Oxford, 1907. (Price, 2s. 6d.)

This is the third and last book in a series designed to fit candidates for preliminary junior and senior examinations. The first book is largely descriptive, presenting definite pictures of the regions of the globe with an outline of the chief topographic features. The second or junior book presents a causal treatment of geography and gives special attention to the interrelation between the surface forms of the earth, climate, vegetation, and human activities. The third volume considers the world according to its natural regions, political and other divisions

of geography being subordinated to the natural divisions. In their preface the authors express the hope that this volume carries the teaching of the subject up to the point at which university work may profitably begin.

The book is undoubtedly well adapted for the study of teachers and the preparation of students for university courses. The human element is conspicuous on every page. The headings for Africa illustrate the divisions of the subject throughout the book: "The Mid-World Deserts," "The Sudan," "The Guinea Lands," "The East African Savannas," "Africa South of the Zambezi," "African Islands" and "The Mediterranean Regions," which is treated in a previous chapter as relating chiefly to Europe.

Most of the numerous maps and diagrams are very suggestive and are helpful to the text. They are particularly clear, as each elucidates only one topic, and they will induce reflection and stimulate the student to consult the best atlases.

Leitfaden für Ansiedler. Unter spezieller Verteilung von West-Usambara (Deutsch-Ostafrika). Von Hans Kurt v. Schrabisch. 71 pp., C. A. Schwetschke & Son, Berlin, 1907. (Price, M. 1.)

The author is thoroughly convinced of the practicability of colonizing a considerable part of German East Africa with peasant farmers. He believes that small holdings are to be desired rather than large plantations. His monograph is filled with information that is essential for the pioneers who go forth to reduce wild nature in this part of Africa to human uses.

Practical European Guide. Preparation, Cost, Routes, Sight-Seeing. By M. D. Frazar. Second Edition. vi and 187 pp., Index. Herbert B. Turner & Co., Boston. 1907.

This book, which fits a small pocket, is packed with practical and useful hints in regard to foreign travel. Many of these hints supply helpful information not always found in the guide-books. Here is a bit of advice, for example, that will often be found worth while:

> It is well on arriving at a city to ask the hotel porter to inform you what permits are necessary in sight-seeing. For instance, by applyiug for permits to the right authorities one may see the sewers and catacombs of Paris, and part of the Conciergerie in which Marie Antoinette was confined. In London permits will open special rooms in the London Tower, also will allow one to visit the Royal Stables, the Mansion House, etc.

Wirtschaftsgeographie der Vereinigten Staaten von Nordamerika. Von Prof. Dr. A. Oppel. 159 pp., 11 Diagrams. Gebauer-Schwetschke, Halle a S., 1907. (Price, M. 3.50.)

This is a well-arranged compendium of the economic conditions and development of the United States written by a German educator who has had much experience in presenting to students the subject of commercial and economic geography. He has supplemented his own studies in this country by preparing special tables and other data from the voluminous material officially published and his comparatively short work is one of the most edifying that has been written on this subject. It appears as one of the series on the subject of "Angewandte Geographie" (Applied Geography) which is being issued by this publishing house.

Dr. Oppel first enumerates the reasons making it difficult to treat the economic geography of this country satisfactorily, such as its rapid development and the fact that a statement of the economic factors this year may not fit the conditions

a few years from now. He then describes the natural conditions on which our progress is based, the development of the American people and their industrial characteristics, and gives about two-thirds of the book to a very clear and suggestive exposition of our products, industries, trade, and communications. The diagrams are excellent, facts are accurately given, and the comments are illuminating. A considerable number of our place-names are misspelled.

Economics of the Iroquois. By Sara Henry Stites. Bryn Mawr College Monographs, Vol. 1, No. 3. vii and 159 pp. Bryn Mawr, Pa., 1905.

The significance of Iroquois institutions is made clear by comparing the environment of these Indians with other environments in North America and their manner of life with the manner of life of other Indian tribes. This adds to the geographical value of the book, for all the geographical influences upon primitive life and activities in North America are fully set forth. As the potential utilities of one geographical environment differ from those of another, the processes of utilization must also differ. The author, therefore, begins the work with an introduction describing typical environments, such as the arctic, the barren, the forest, the plain, etc., and the nature of the potential utilities characteristic of each of these environments and which seem to determine the economic life of the inhabitants.

The author then discusses the environment of the Iroquois, their productive activities, the division of labour, the organization of producers, the wealth of the Iroquois and its distribution, and their methods of exchange by barter, the use of wampum, etc.

In Part II the sociological results of the conditions thus far treated are discussed in chapters on the family, the state and government, and the religion, morals, and general culture of the Iroquois. The whole subject is logically presented with unfailing clearness and strength of expression, with scientific accuracy, and with copious references to sources of information. The work is a most desirable addition to the literature of the development of primitive societies.

Jean Nicolet et le Canada de son temps (1618–1642). **Par Abbé Auguste Gosselin.** viii and 282 pp. J.-A. K.-Laflame. Quebec, 1905.

In this fascinating narrative Dr. Gosselin sketches the Canada of Nicolet's day while telling the story of this brilliant man, who in twenty-four years won lasting fame for his discoveries in America and the intimate knowledge he acquired of the everyday life and the languages of a number of great Indian tribes. Nicolet lived and worked in Canada in the first days of the colony. He helped to found the town of Three Rivers, he knew the earliest missionaries, and witnessed the beginnings of Church influence in the wilderness. To write his biography it is to describe the origins of the colony. The author tells the absorbing story of Nicolet and his work with full knowledge and abounding sympathy and with a charm of style that adds much to the value of the book. He makes abundant use of the testimony of other writers that may throw further light upon the Canada that Nicolet knew.

Führer von Hamburg nach Sudamerika in deutscher und portugiesischer Sprache. 211 pp., Illustrations. Henschel & Müller, Hamburg. (Price, M. 5.)

The German and Portuguese texts are printed on opposite pages. The pur-

pose is to give the traveller all essential information concerning the journey by North European steamers to Brazil, Uruguay, Argentina and their principal cities. The book fits the pocket. Forty-one ports and cities are well described from the point of view of the tourist's needs. The half-tone pictures are a helpful addition to the text.

Svenska Turist-Föreningens Arsskrift för ar 1907. viii and 446 pp. Illustrations and Maps. Wahlström & Widstrand, Stockholm, 1907.

The Yearbook of the Swedish Touring Club, as usual, abounds with numerous handsome photographs, showing many of the aspects of Sweden, both in summer and winter, and accompanied by entertaining letterpress. Both reading matter and illustrations are the work of members of the club.

Early Settlement and Growth of Western Iowa, or Reminiscences. By the Rev. John Todd. 203 pp. Portrait and Index. The Historical Department of Iowa, Des Moines, 1906. (Price, $1.25.)

Mr. Todd went to Iowa in 1848 and helped to found the town of Tabor in the southwest corner of the present State, about thirty-three miles from Omaha. His book is a narrative of the trials, hardships, and triumphs of those sturdy pioneers who helped to lay the foundation of Iowa's greatness. The settlers saw great possibilities, but everything had to be done. Hardship and privation were matters of course, and frugality, courage, endurance, and resourcefulness were the essentials of ultimate success. In Mr. Todd's little colony, hulled corn was long the main diet, wheat bread was a rare article, houses were sometimes built without shingles, boards, or nails, lumber was hard to get, and the first winter was full of suffering, due to the delay of the promised saw mill. The author's reminiscences carry the story of development through those early times, and he lived to see a flourishing college at Tabor and the large and prosperous population of Iowa in full enjoyment of all the blessings of civilization. As Tabor was not far from the Kansas border, the community was deeply involved in the Kansas troubles of 1856, when slaveholders opposed with arms the advent of Abolitionist settlers. An underground railroad had its southern terminus at Tabor, and many an escaped slave was piloted northward to Canada. A chapter is given to the Indians of Iowa. The book describes a very important and stirring era in the history of the State, and is a record worth preserving.

Life by the Seashore. An Introduction to Natural History. By Marion Newbigin. vii and 344 pp., 93 Figures, Bibliography, and Index. Swan Sonnenschein & Co., Ltd., London, 1907.

An invaluable book for summer visitors to the seashore. Life is extraordinarily abundant along the water side. The purpose of the book is to enable those who have no special zoological training to learn the names and nature of the common inhabitants of the shore. In the introductory chapter, the author describes the conditions of shore life, the food supply, and the peculiarities of shore animals. Following this sketch are fifteen chapters giving hints as to methods of observation, and descriptions of the various animals sufficiently detailed to enable the reader to identify actual specimens. The book is scientifically accurate, is simply written, and may be comprehended by any intelligent person. Miss Newbigin's text is greatly helped by numerous drawings from life by her sister. It is a fascinating book for those of the general public who have a liking for nature study.

Handbook of the Federated Malay States. Compiled by H. Conway Belfield, British Resident of Selangor. (Third edition.) 184 pp., 3 Appendices, and Maps. Edward Stanford, London, 1906. (Price, 2s. 6d.)

The successful cultivation of Pará rubber in the Malay States has brought them into greater prominence and enlarged the number of readers who will be interested in this volume. Much of the text has been rewritten for the present edition. The Federated States are Perak, Selangor, the Negri Sembilan, and Pahang. In 1895, the Sultans agreed to constitute their countries a Federation, to be administered under the advice of the British Government. Wars have ceased, railroads, waggon roads, and telegraphs have been introduced, hospitals have been built, sanitary measures have been enforced, mining has developed, the influx of Chinese, Tamils, and other Asiatics who supply manual labour has greatly increased, and the States are turning their material resources to better account. The Handbook is filled with information relating to all the natural conditions of these States, their resources, inhabitants, methods of cultivation and mining, flora and fauna, methods of planting, exterior communications, and many facts valuable to foreign capitalists, settlers, and visitors.

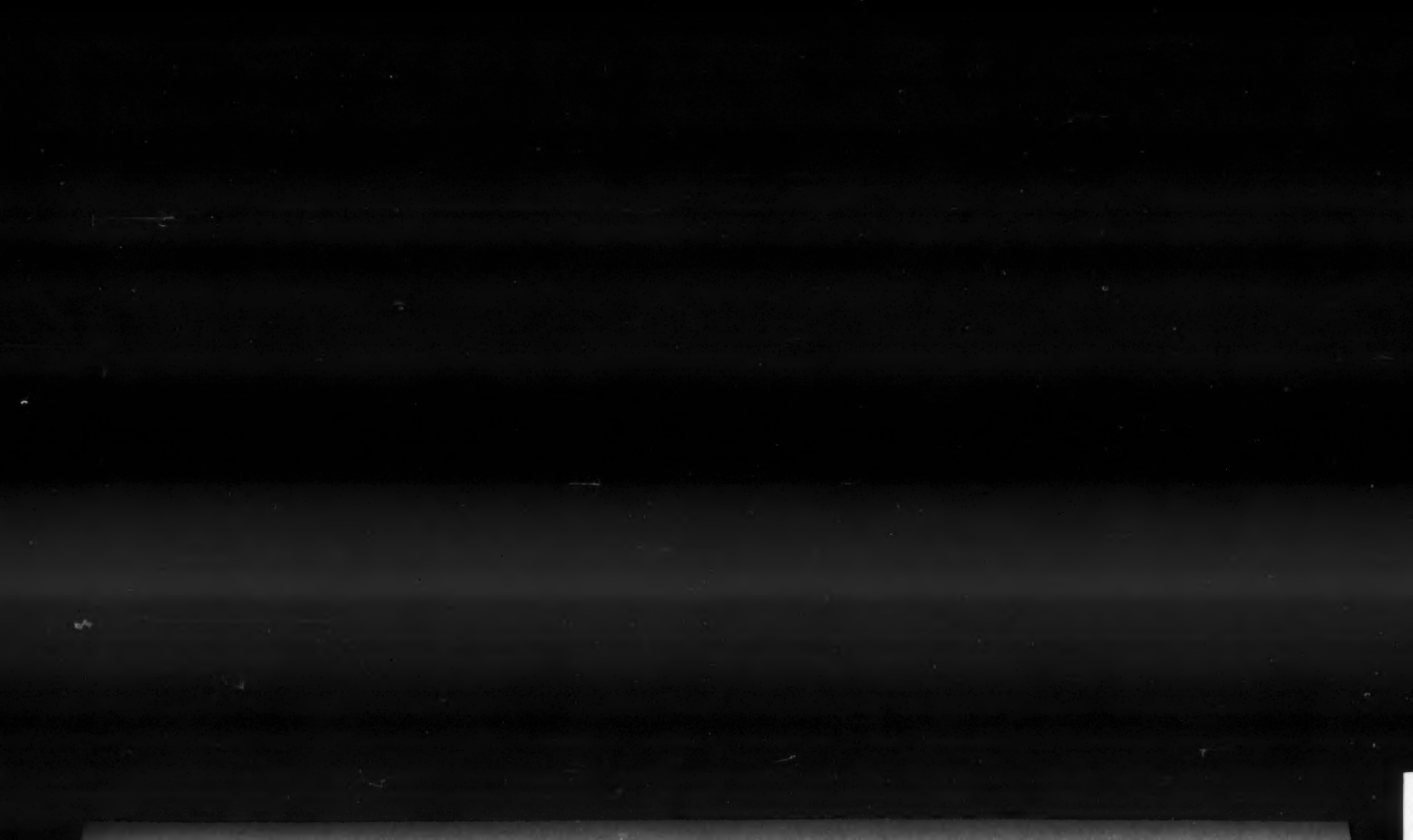
The cost of opening and caring for a plantation of Pará rubber, 500 acres, for eight years, is about $143,875, including the cost of the land and clearing it of the virgin forest. The tree should not be tapped before the sixth year, but in the sixth, seventh, and eighth years the return from the rubber product should be about $159,375. In the ninth year the production is estimated at 300 pounds per acre, and the crop would be worth about $211,500. The oldest trees, about sixteen years, are yielding annually from 10 to 15 pounds per tree of pure, coagulated rubber, and they are also supplying large crops of seed.

Verkehrsentwickelung in Deutschland, 1800-1900. Von Prof. Dr. Walther Lotz. (Second edition.) viii and 144 pp. B. G. Teubner, Leipzig, 1906. (Price, M. 1.25.)

This is one of the admirable books in the large collection published by Teubner, known under the title "Aus Natur und Geisteswelt." The work treats concisely, but in a most informing and suggestive manner, of the development of communications in Germany during the eighteenth century, and incidentally throws all essential light upon the subject of the gradual evolution of routes throughout the world. It presents facts and the deductions to be drawn from them, and everywhere shows the relation between communications in their various stages of development and mankind.

Very little was done until the nineteenth century to improve the conditions of navigation on the German rivers, and from the Middle Ages to the nineteenth century there were many artificial impediments to the utilization of these rivers. There were, for example, on the Elbe from Hamburg to Magdeburg, about the year 1800, fourteen stations where tolls were collected from river vessels, and 33 toll stations were scattered on the Main from Bamberg to Mayence. The loss in time at these numerous stopping-places was as embarrassing as the tax itself.

In ancient times and the Middle Ages, canals were constructed through plains, but they could not be built across water partings or through rolling lands until the invention of the lock system about 1450. Both the Italians and Dutch claim the honour of this invention.



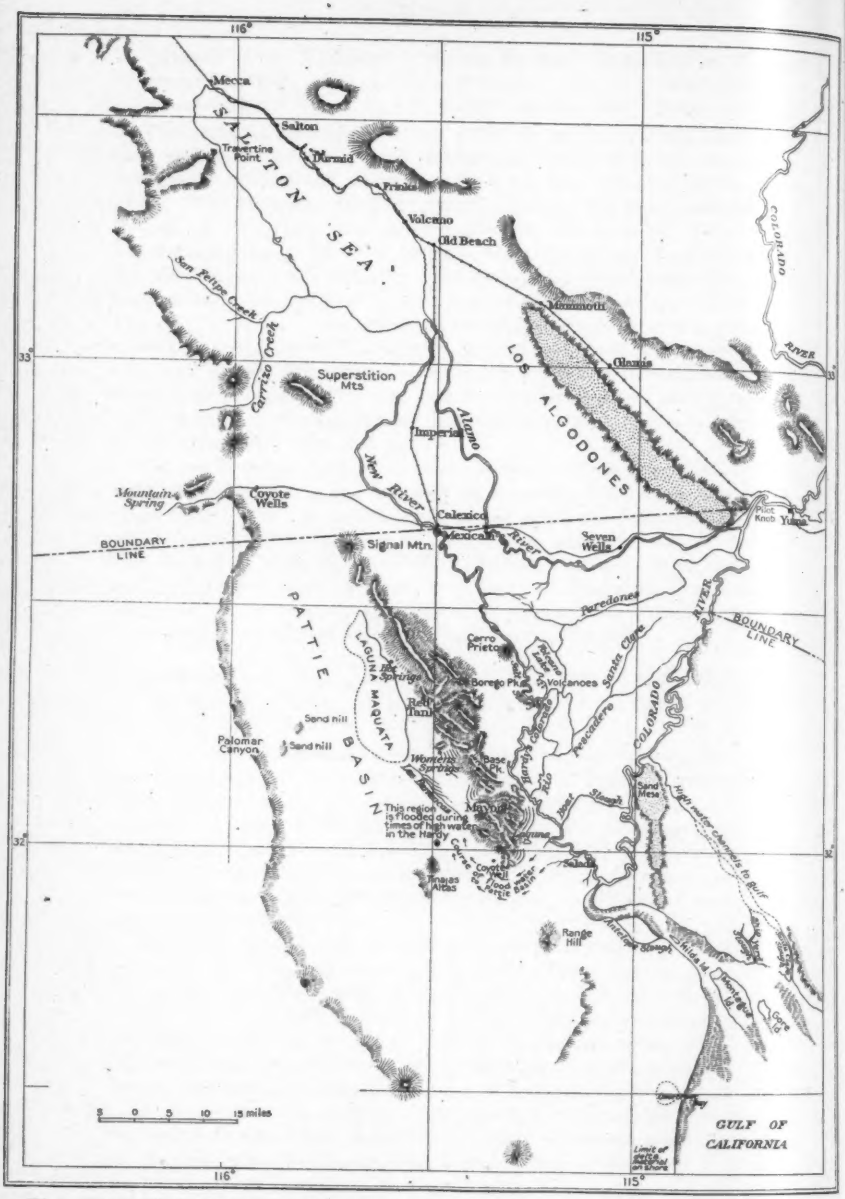


FIG. 1.—MAP OF THE DELTA OF THE COLORADO RIVER, INCLUDING THE SALTON AND PATTIE BASINS. COMPILED AND DRAWN BY GODFREY SYKES.

Bulletin, American Geographical Society, December, 1907.